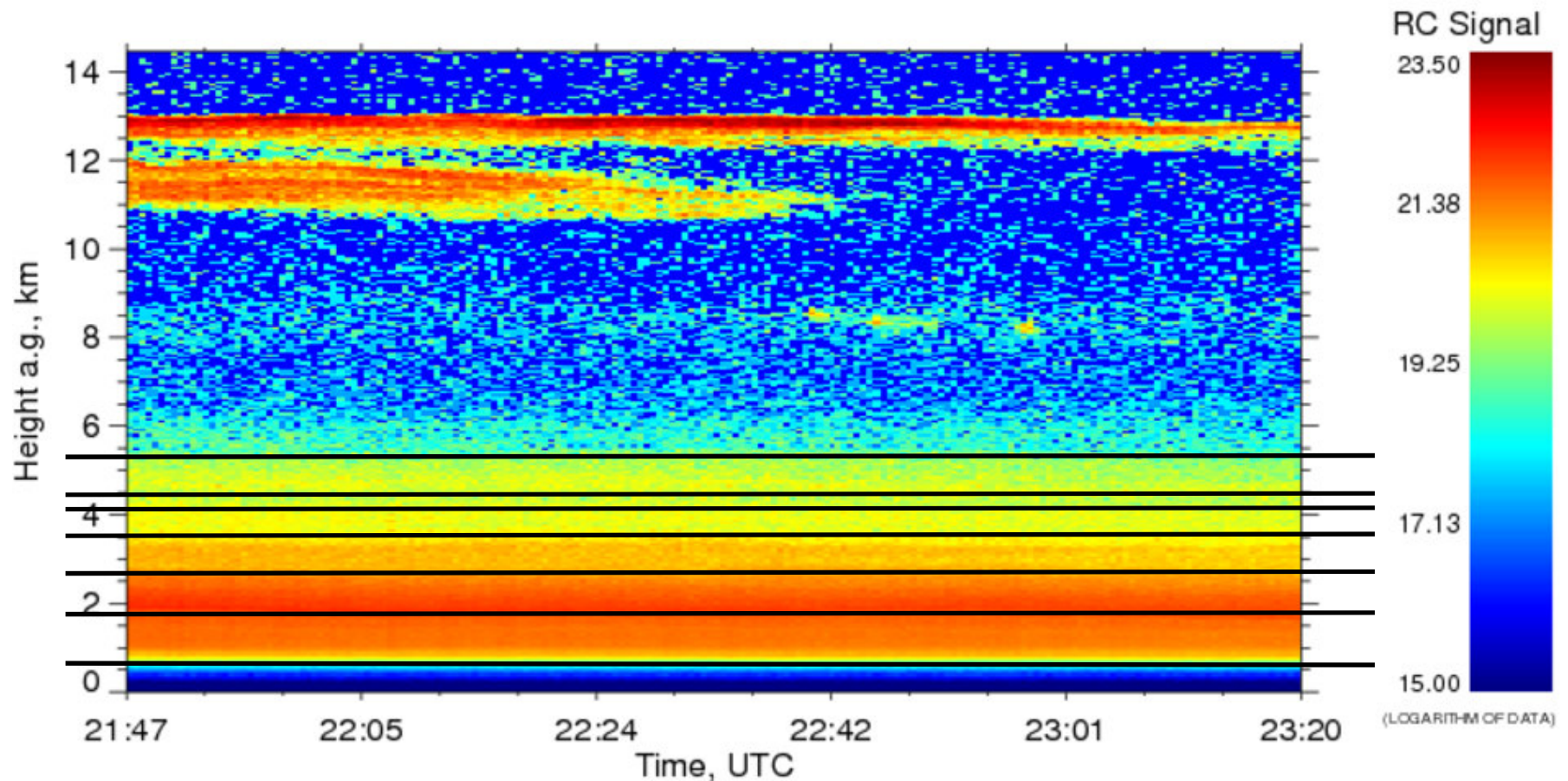# The use of EARLINET data in the ESA-CALIPSO project – feature finding and aerosol typing

Evaluation of measurements for different aerosol types at different stations (WP 5a, b)

Example: Aerosol layer products

1) Feature finding coherent structures in time series plots (= quicklooks)
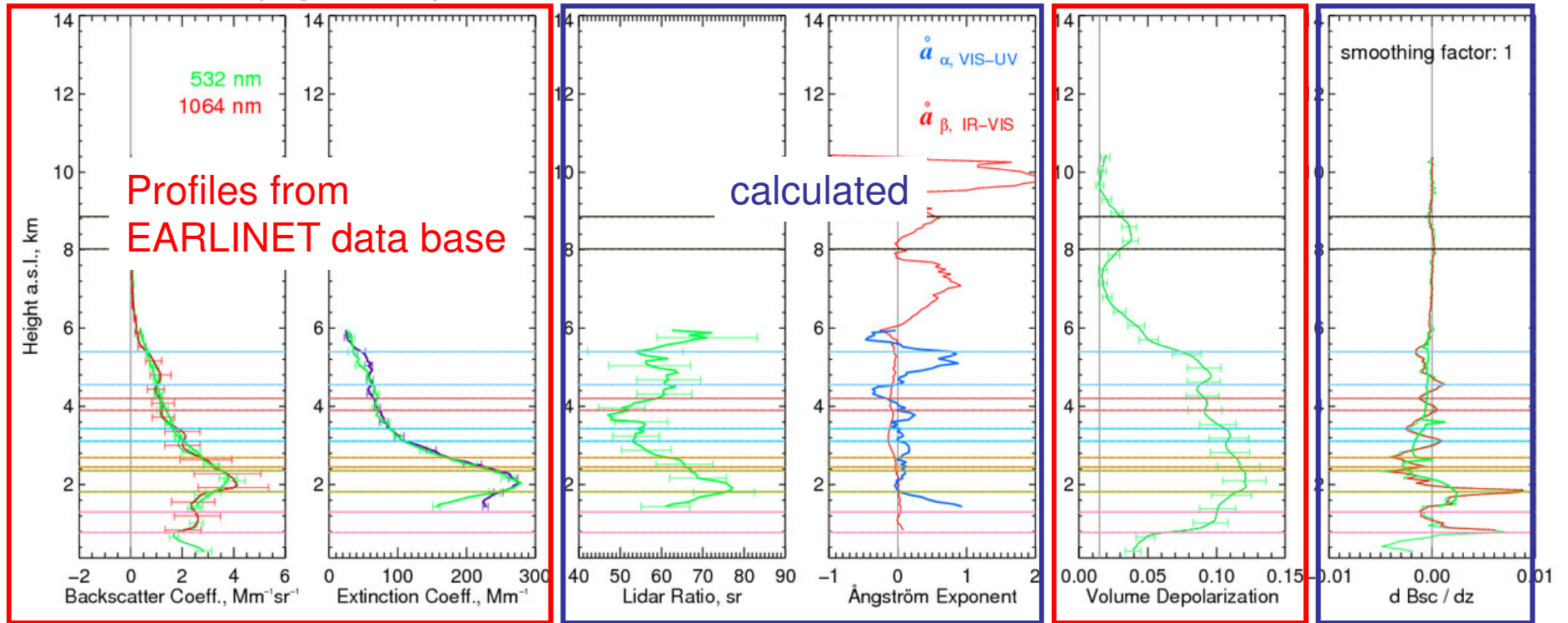

1064 nm range corrected signal, Leipzig, 29 May 2008

Optical properties Leipzig, 29 May 2008, 21:47 – 23:20 UT

backscatter
significantly
larger than 0
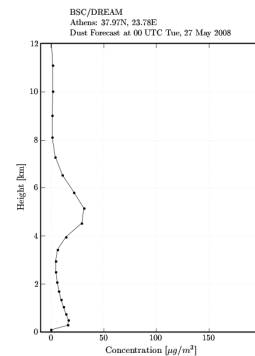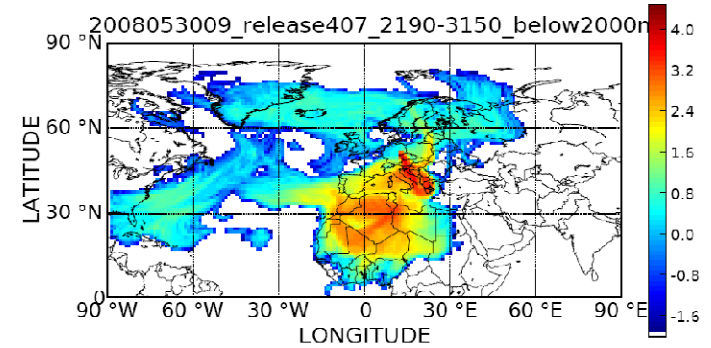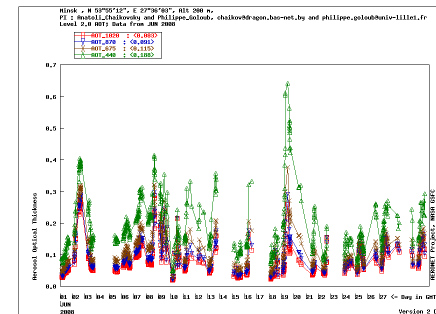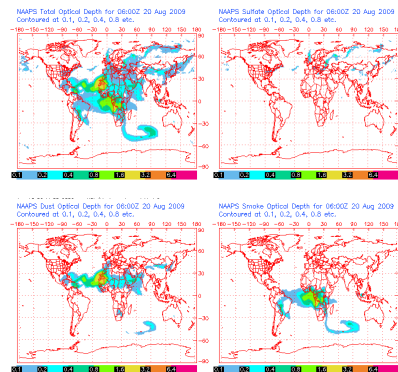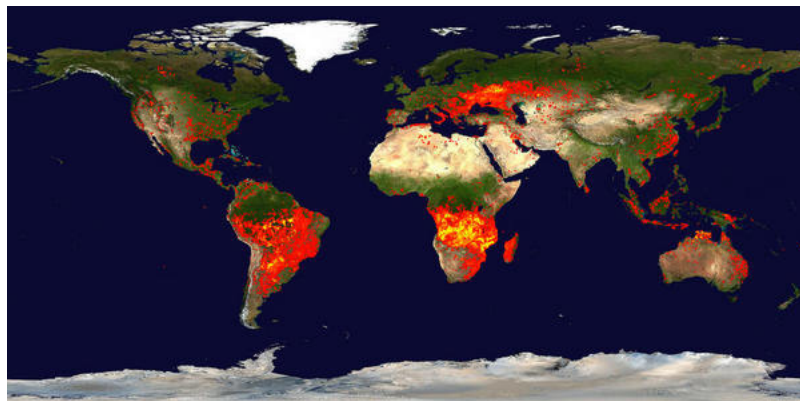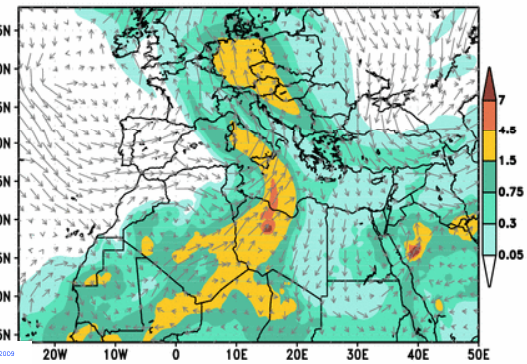
derivative
method:
d Bsc / dz

→ feature boundaries

Identification of source, type and age of aerosol

- different trajectory and transport models (FLEXPART, DREAM, HYSPLIT,…)

- MODIS fire maps

- NAAPS (Navy Aerosol Analysis and Prediction System)

- AERONET data

- …

Major aerosol types used in this study

- **Marine/oceanic aerosol**

- **Mineral dust aerosol**

- **Polluted continental / anthropogenic pollution / urban aerosol**

- Clean continental aerosol / rural aerosol

- **Biomass-burning smoke aerosol**

    + dependence on source region
    + mixtures of different types
    + processing/aging during transport
    + humidity

Marine aerosol

1) Definition of source regions

2) Case study: Barcelona, 6 August 2008

Definition of marine-aerosol source regions
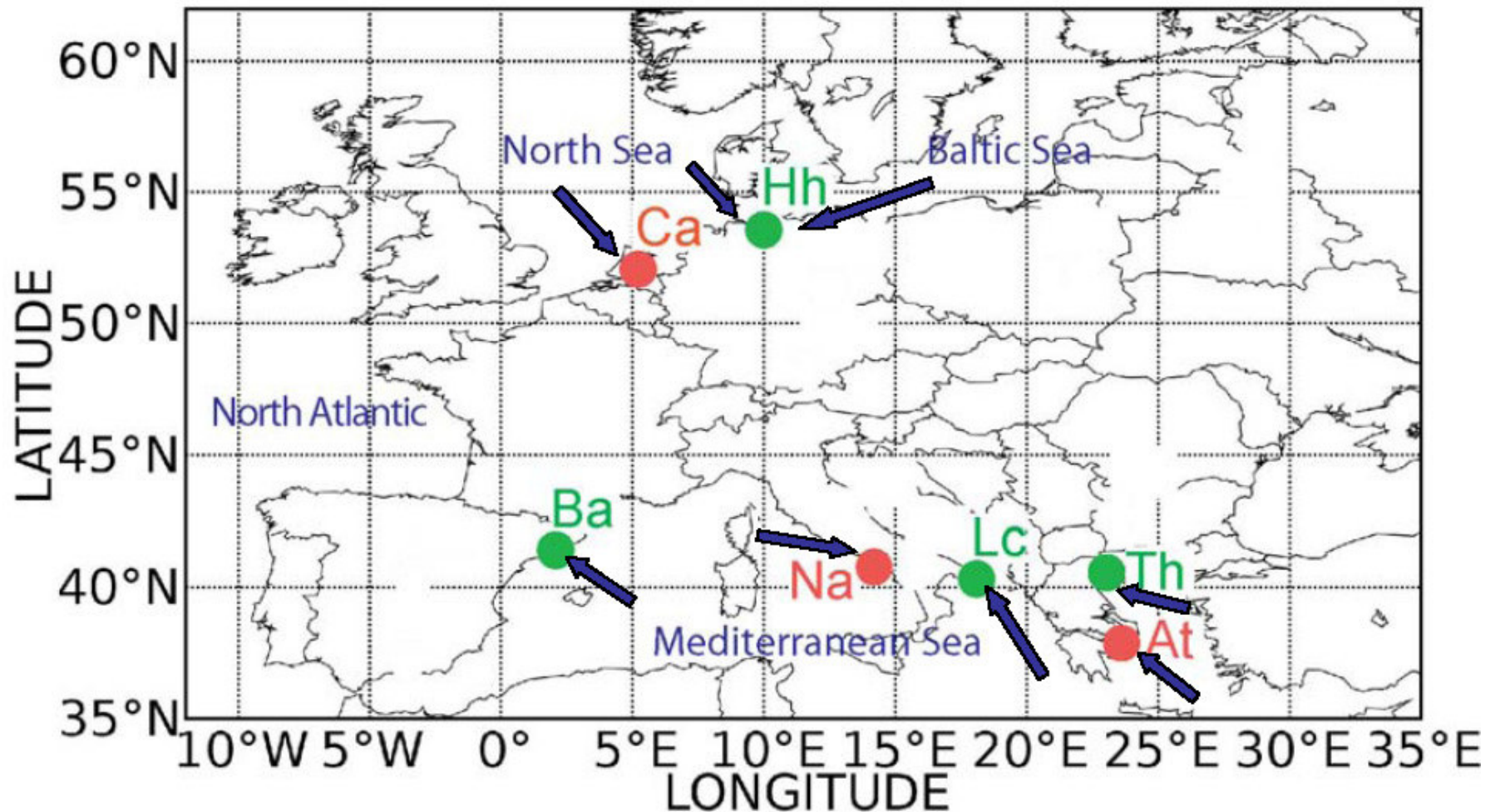
Barcelona, 6 August 2008, 01:42 – 04:11 UT

532 nm   1064 nm

FLEXPART footprint below 2 km, Barcelona, 6 August 2008
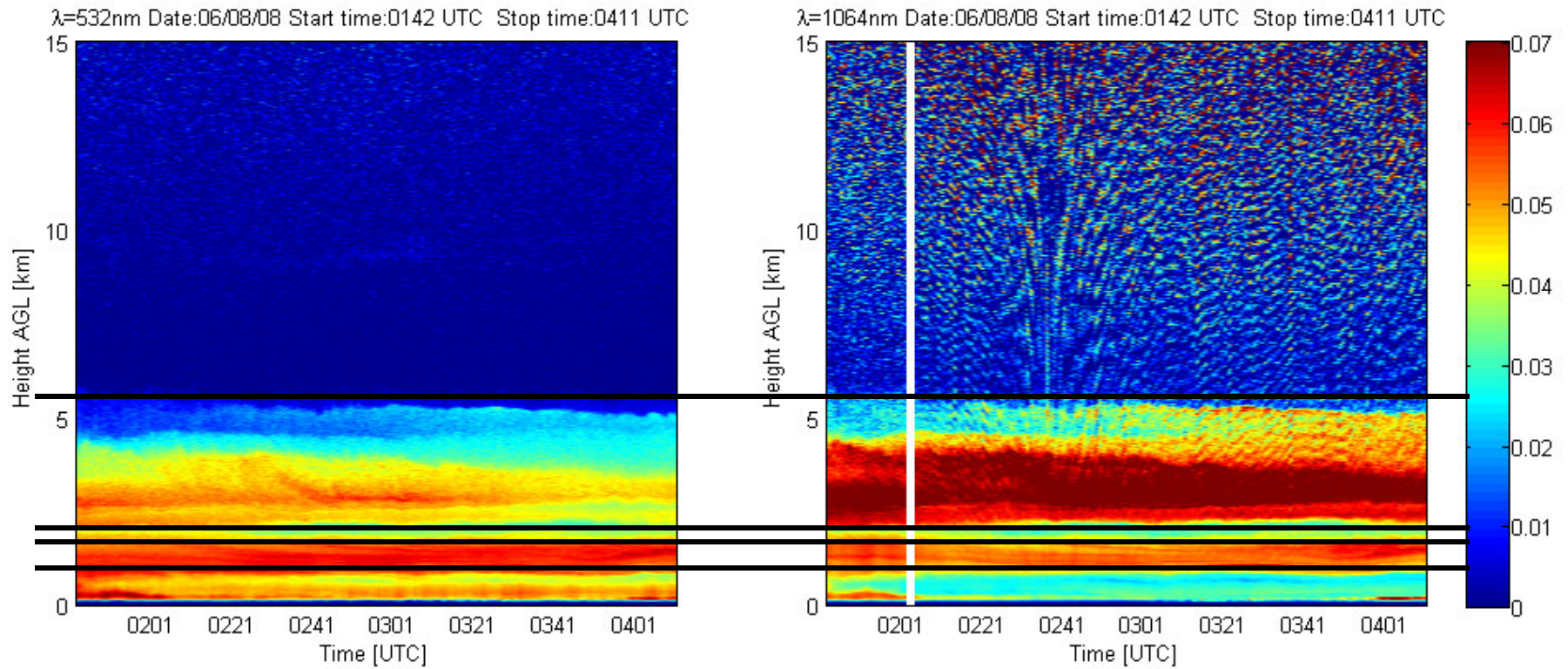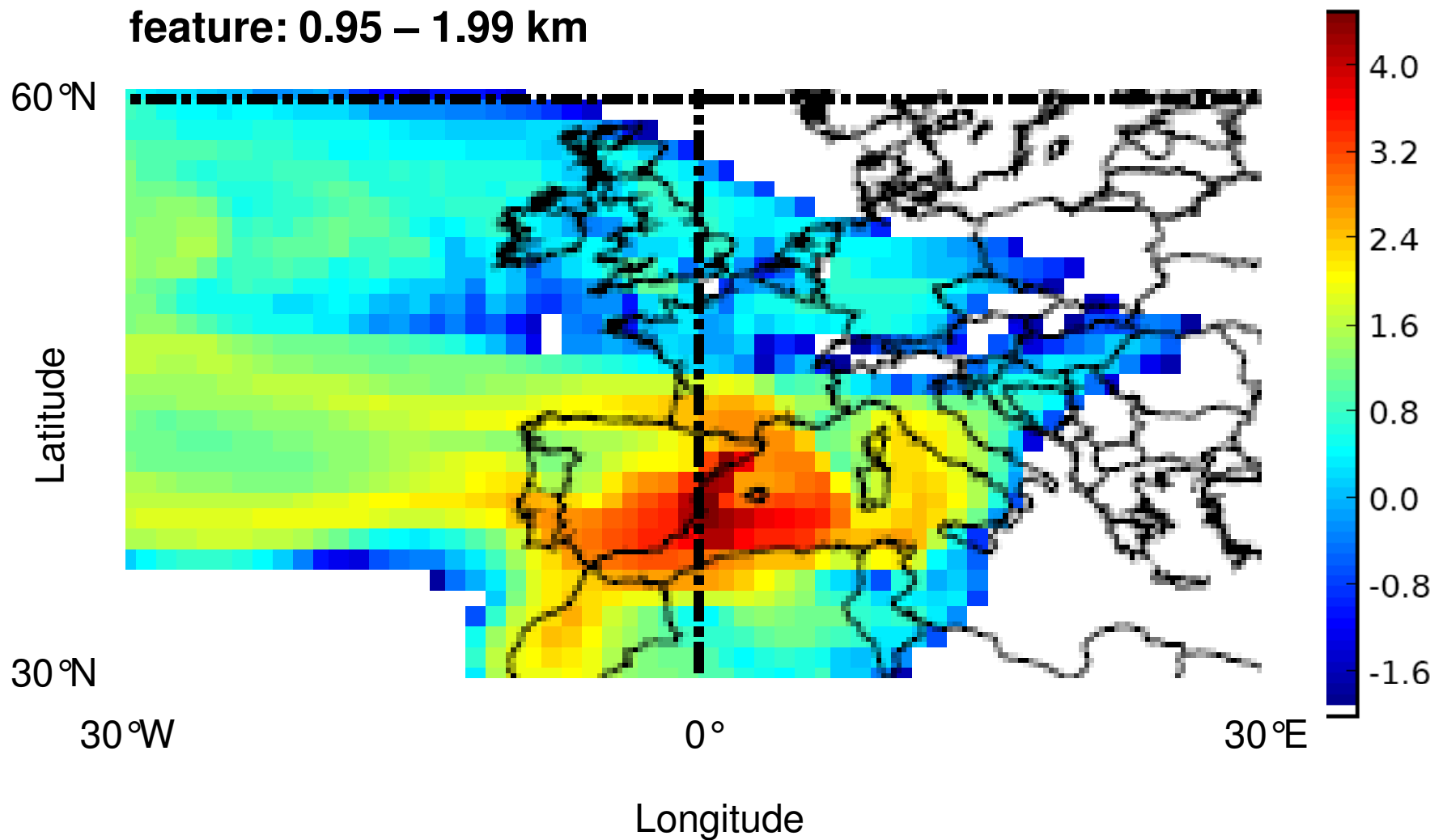

feature: 0.95 – 1.99 km

FLEXPART time series, Barcelona, backwards from 6 August 2008

20080805   **20080804**
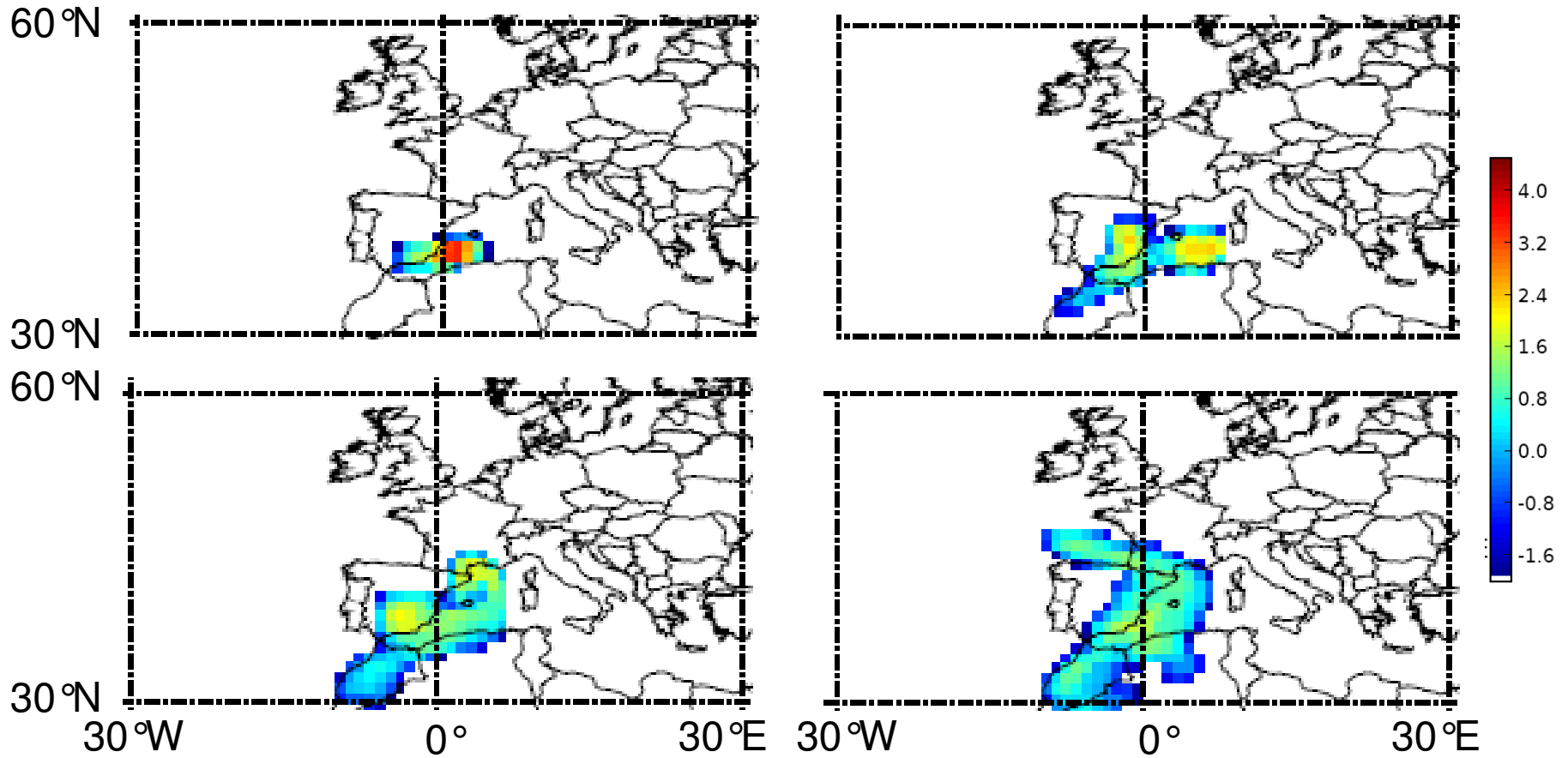
feature: 0.95 – 1.99 km

20080803   **20080802**

Optical properties, Barcelona, 6 August 2008, 01:42 – 04:11 UT

DATE: 20080806   TIME: 014200 – 041100 UT   Case B   Day Of CALIPSO Cycle: 16
STATION: Barcelona, Spain
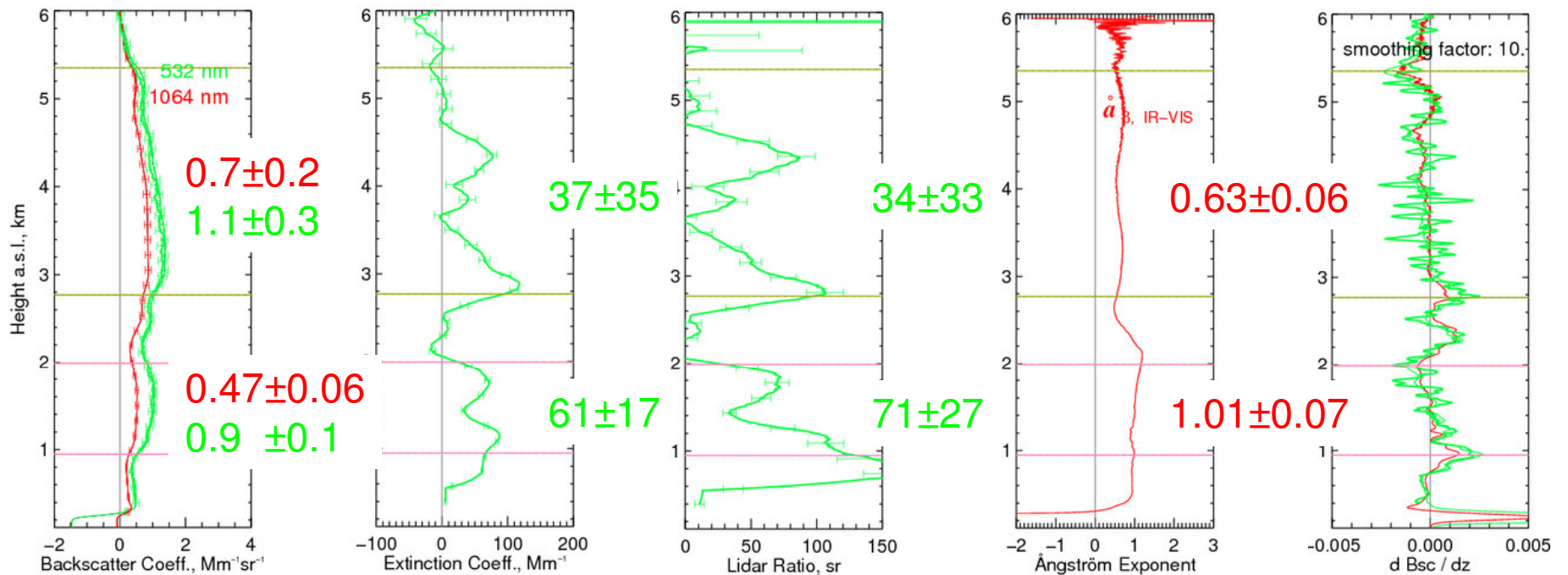
Mineral dust aerosol

1) Dust source regions

2) Case study: Potenza,17 May 2008

Definition of Saharan dust source regions
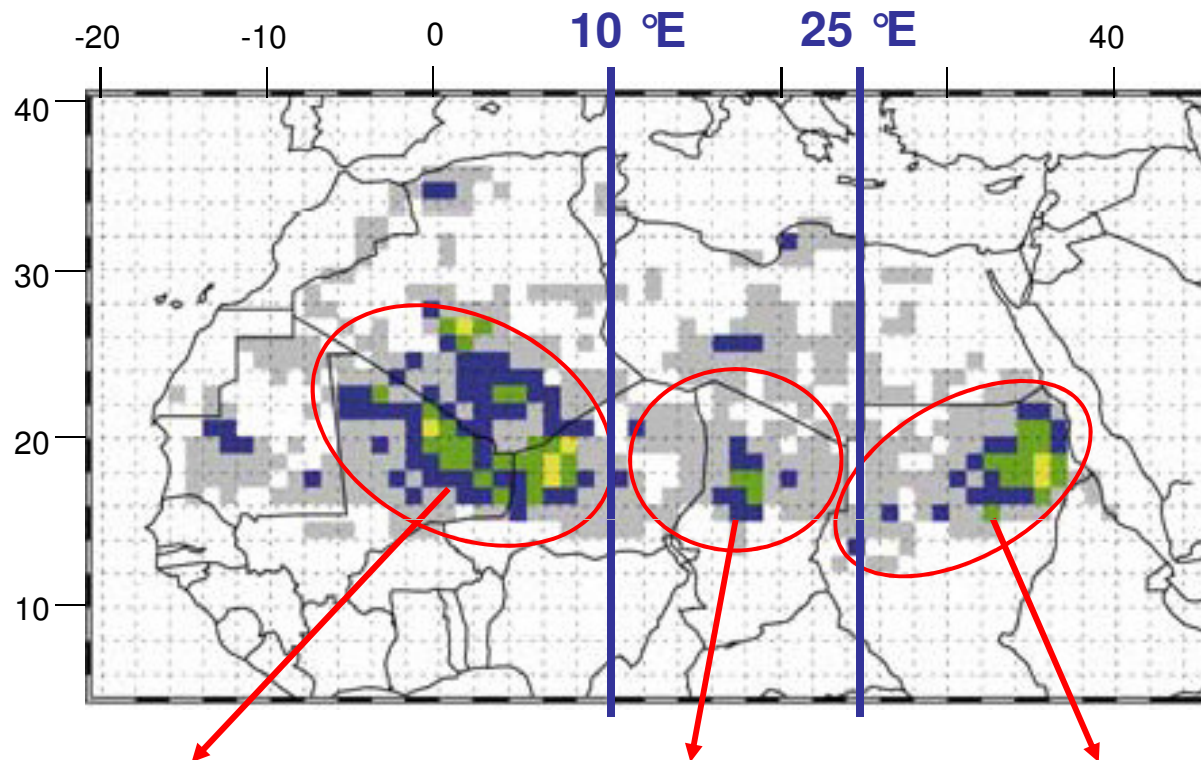
Western Sahara
Foothills of Ahaggar
and other mountains
(Algeria, Mali, Niger)

Central Sahara
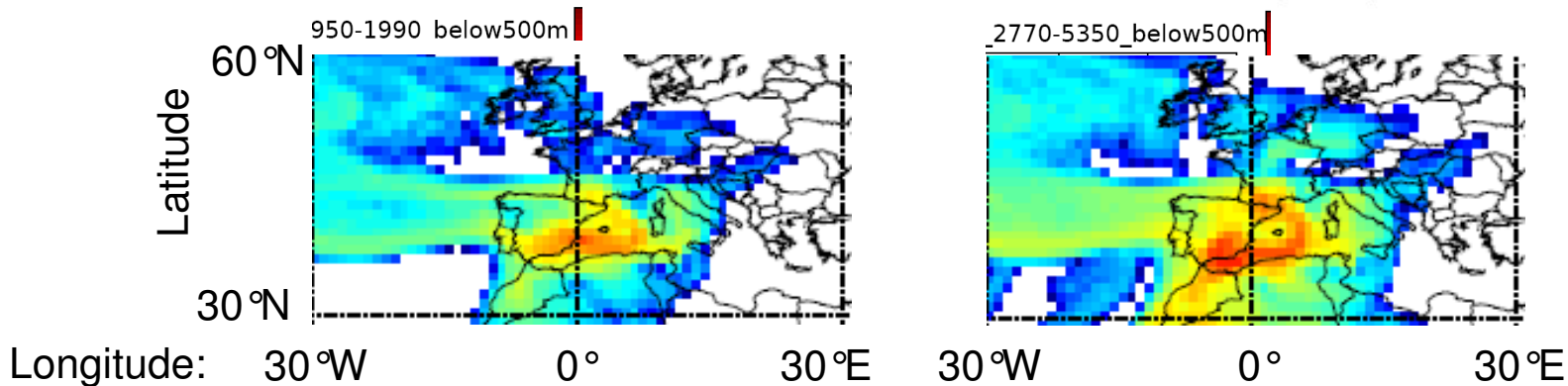Bodele Depression
(Lake Chad Basin)

Eastern Sahara
Foothills of the
Red Sea Mountains
(Sudan)

geographical lows and foothills, dry lakes and rivers
→ mobilization of sediments of fine soil

Prospero et al. 2002
Schepanski et al. 2007

Potenza, 17 May 2008, 1064-nm range-corrected signal

CNR-IMAA - Potenza - 40.6° N – 15.72°E 760 m asl

17 May 2008 - Range corrected signal @ 1064 nm

Optical properties, Potenza, 17 May 2008, 20:22

DATE: 20080517   TIME: 202243 – 205202 UT   Case C   Day Of CAI
STATION: TitoScalo – Potenza, Italy
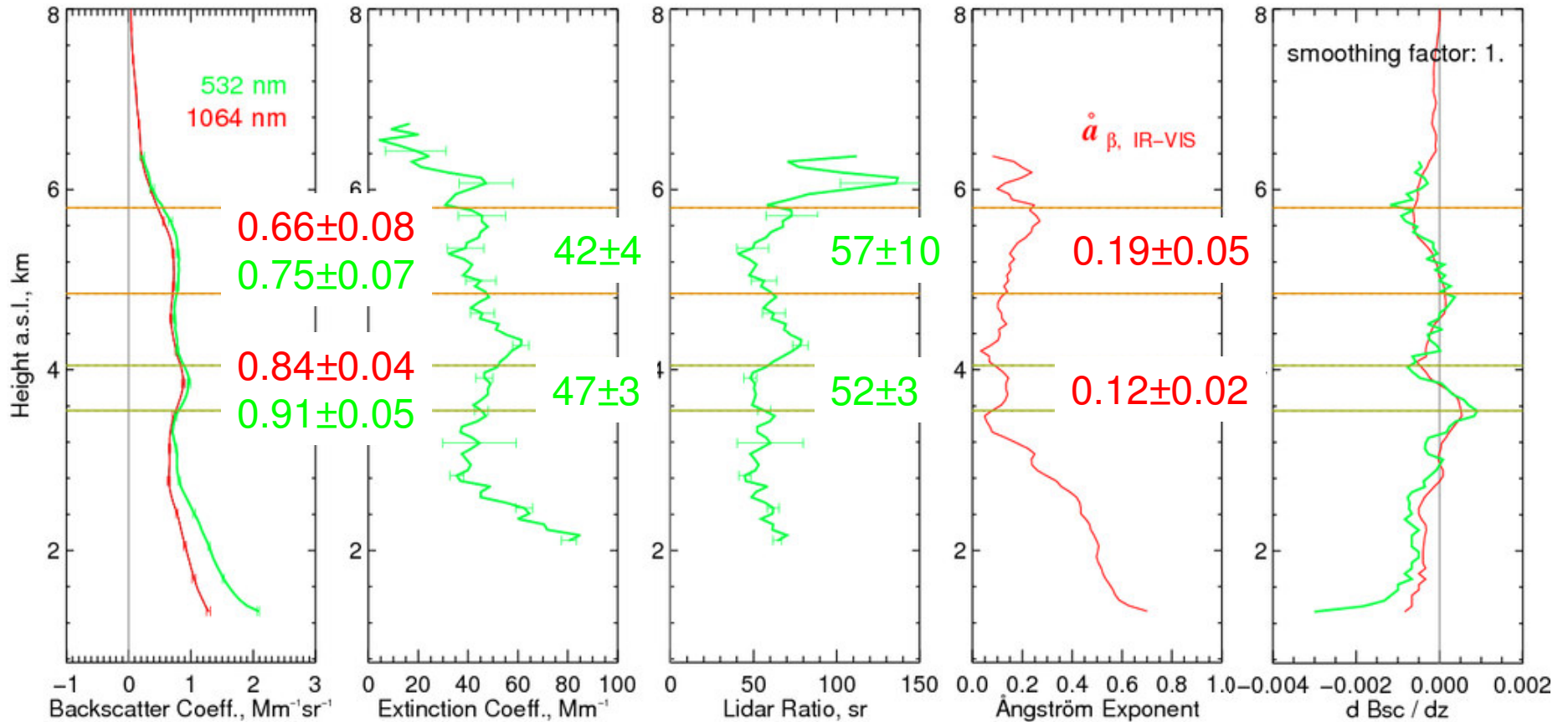
532 nm
1064 nm

0.66±0.08
0.75±0.07

0.84±0.04
0.91±0.05

42±4

47±3

57±10

52±3

$\mathring{a}_{\beta,\ IR-VIS}$

0.19±0.05

0.12±0.02

smoothing factor: 1.

Backscatter Coeff., Mm⁻¹sr⁻¹
Extinction Coeff., Mm⁻¹
Lidar Ratio, sr
Ångström Exponent
d Bsc / dz

Height a.s.l., km

esa

Classification of aerosol with respect to source region
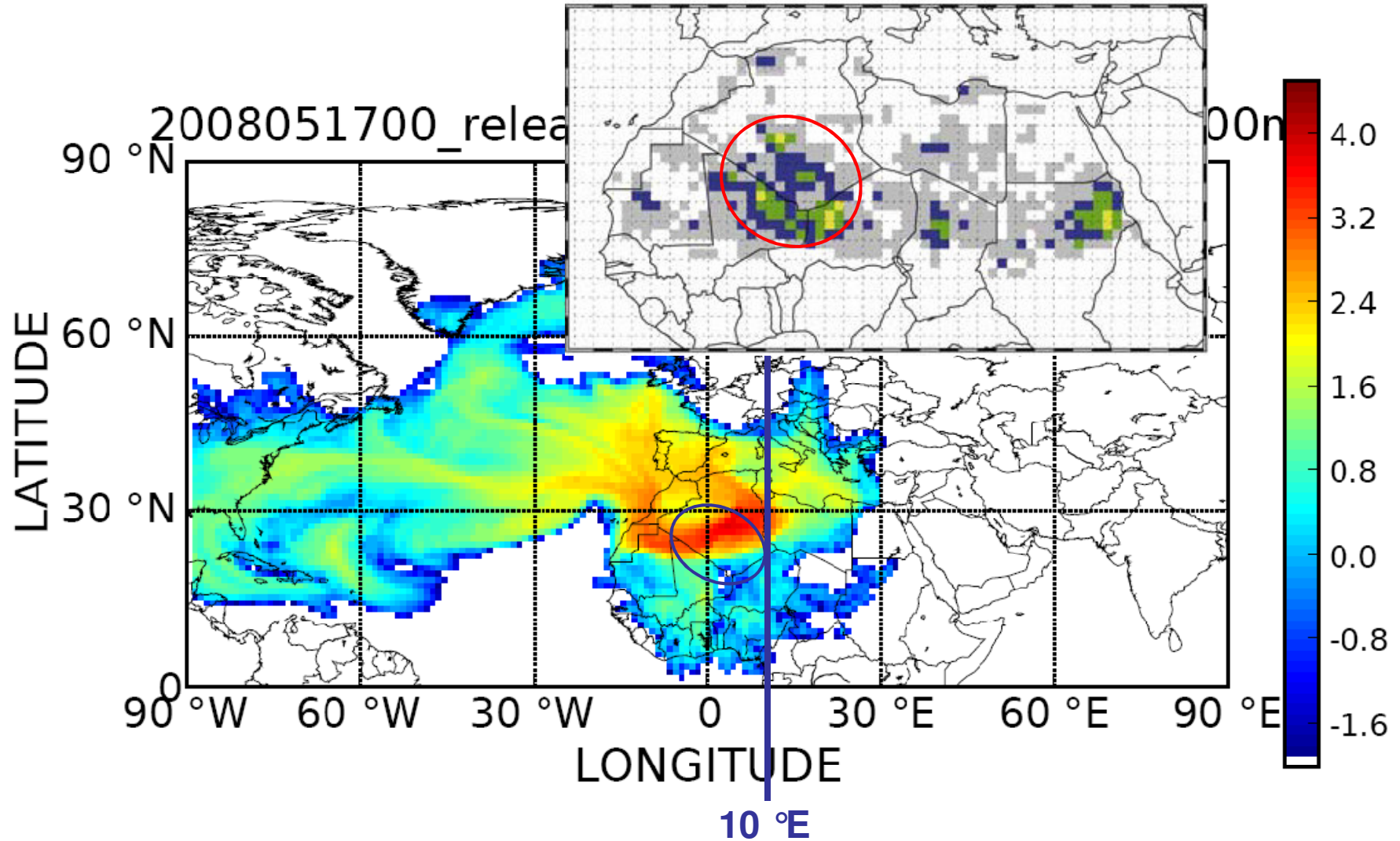
FLEXPART footprint (2000 m) Potenza, 17 May 2008

Classification of aerosol with respect to source region

FLEXPART footprint (2000 m) Potenza, 17 May 2008

Polluted continental aerosol
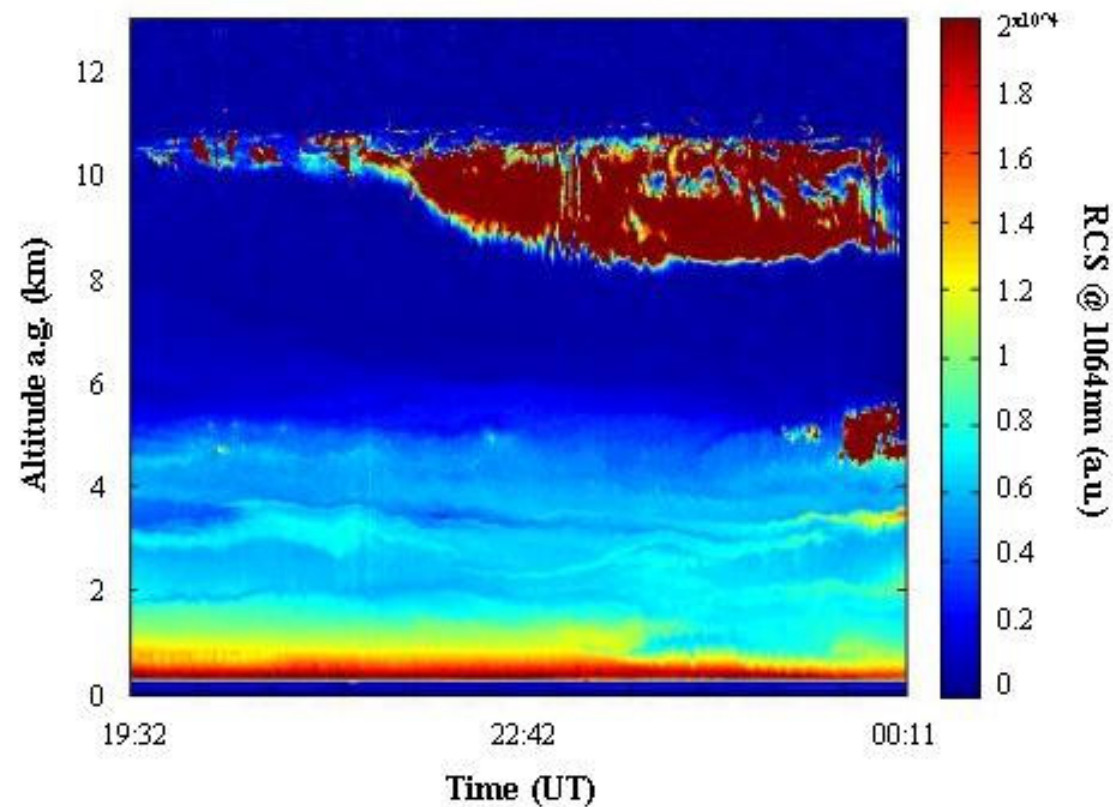
**1) Definition of source regions
2) Case study: Minsk, 14 July 2008**

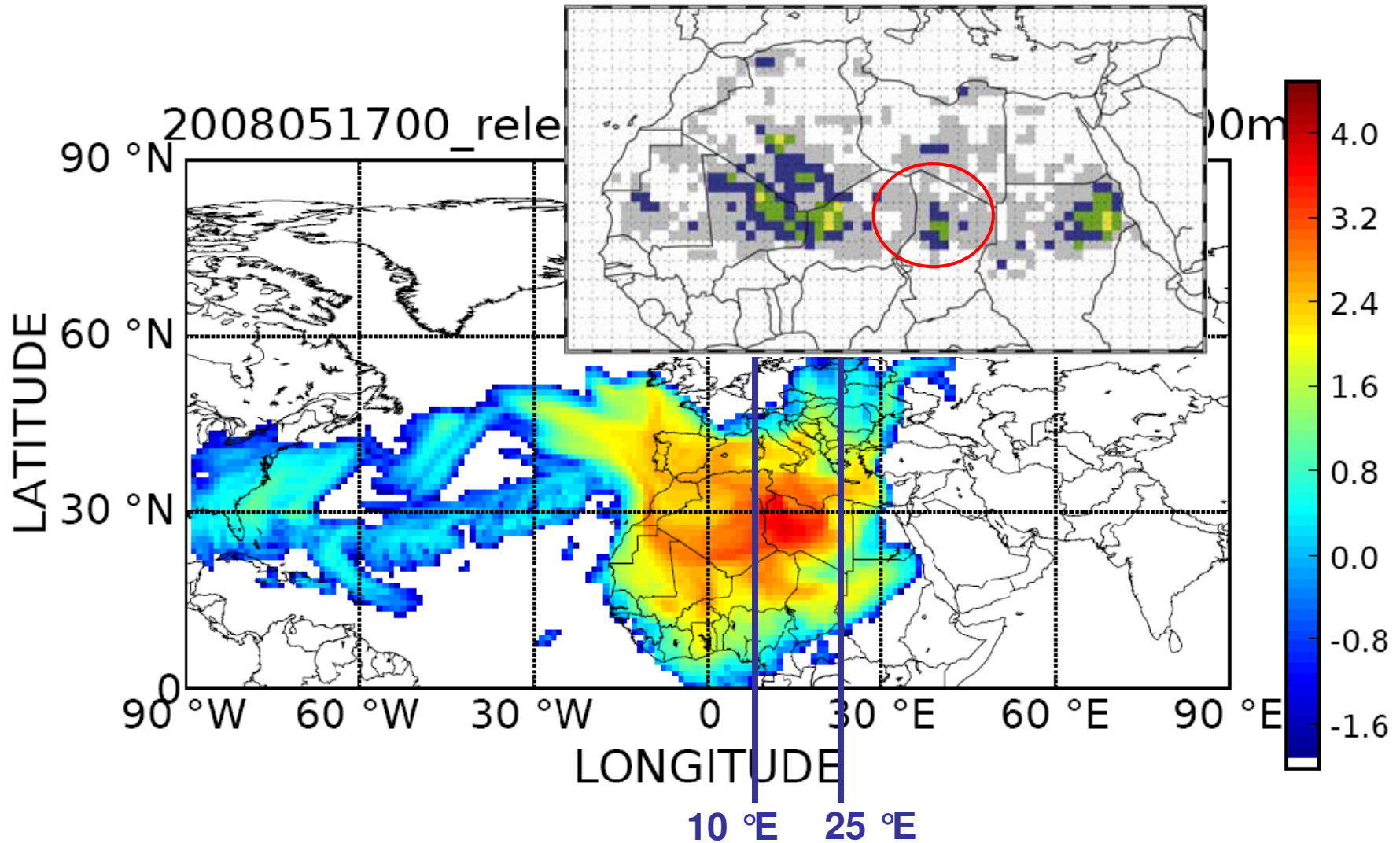# Definition of European source regions for polluted continental aerosol after EMEP emission inventory

CO - Emission 2005

EMISSION / Mg

North

East

West

Central

Southwest

South

Southeast

70°N

50°N

30°N

25000

1000

Polluted continental aerosol from Eastern Europe

CO - Emission 2005
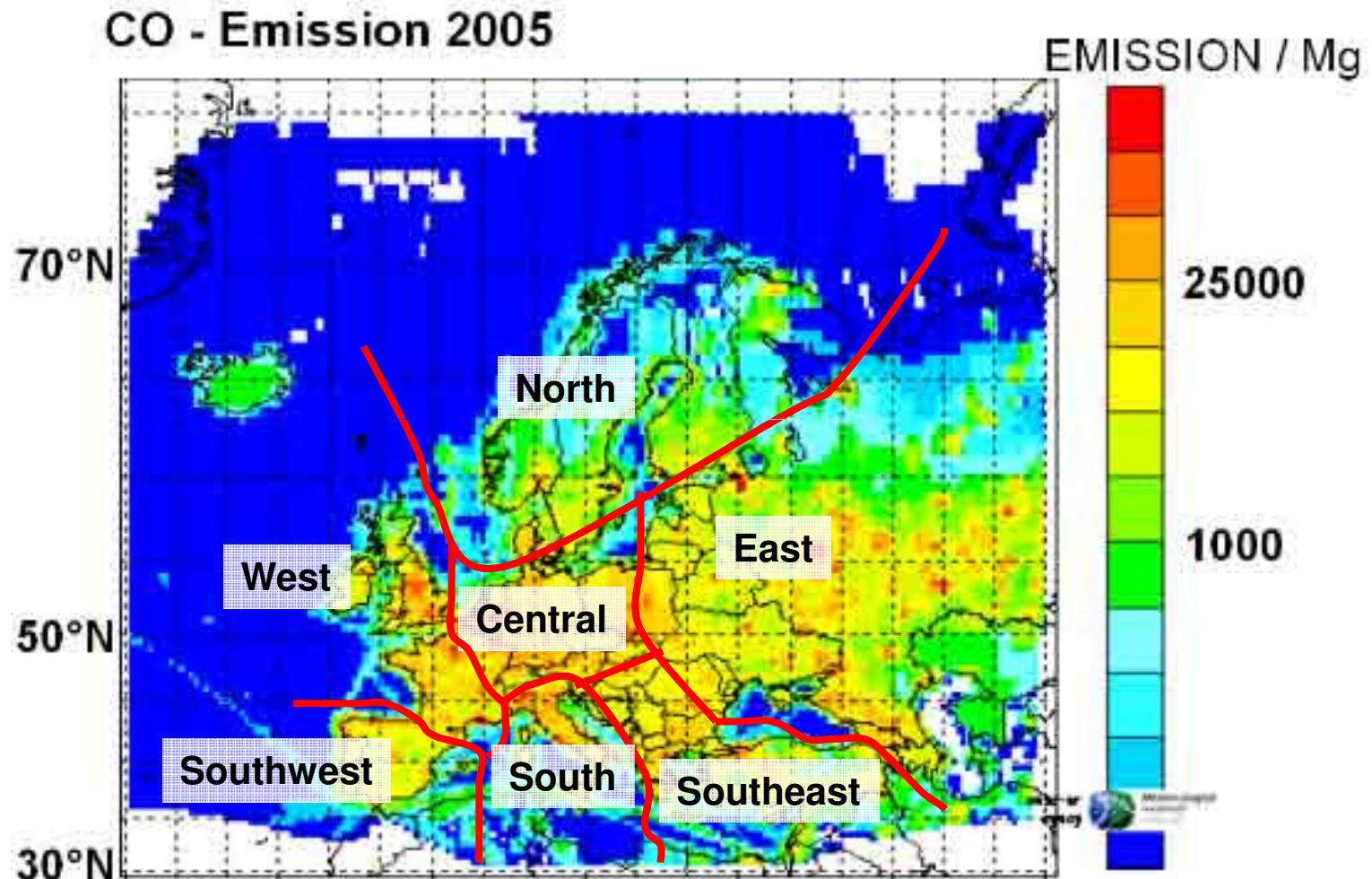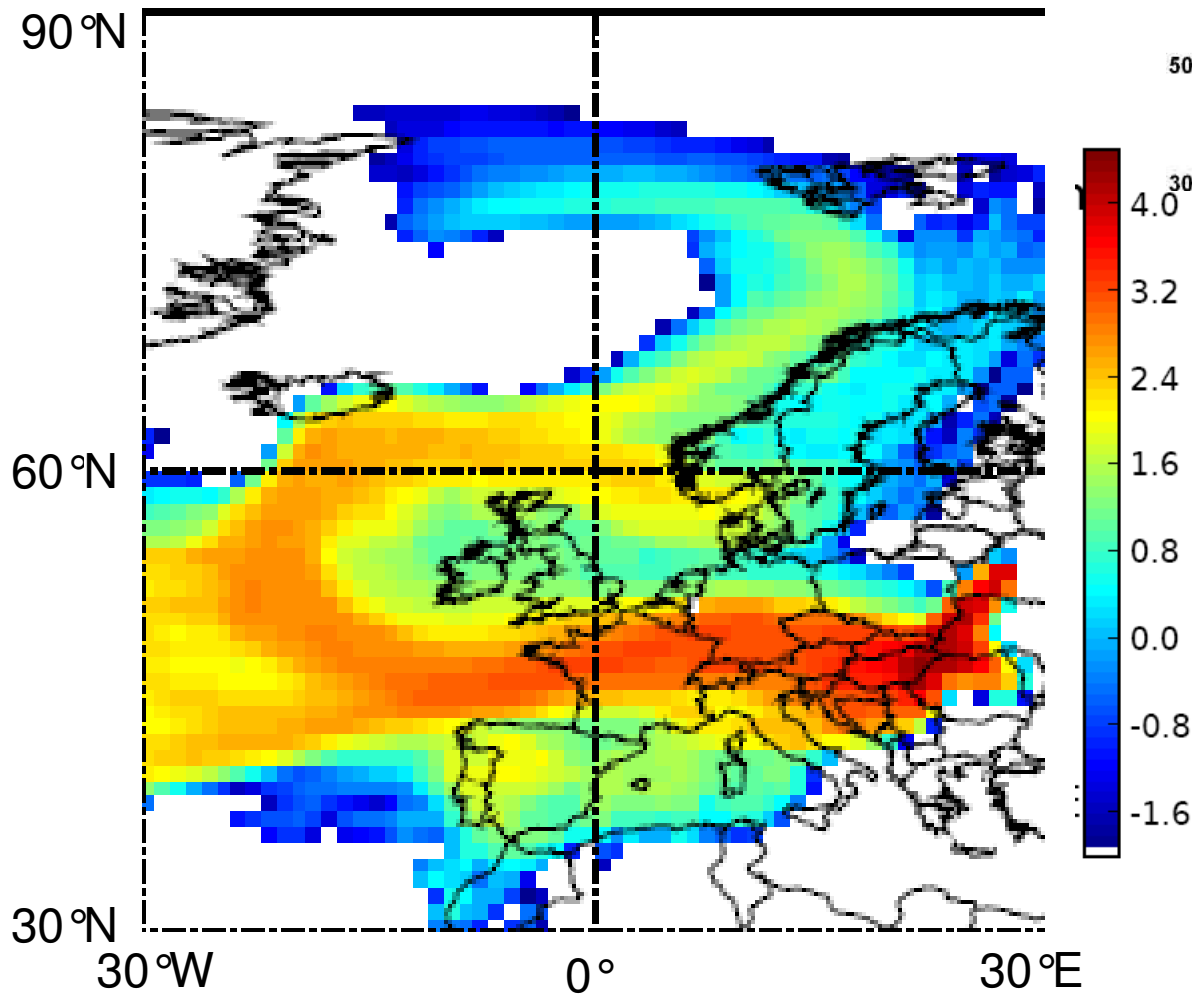
feature: 2.2 – 2.42 km

FLEXPART footprint (2000 m) Minsk, 14 July 2008
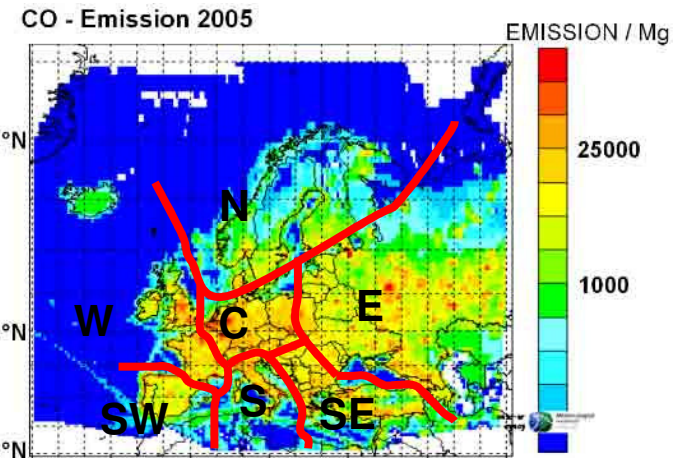
Optical properties, Minsk, 14 July 2008, 00:25 – 01:00 UT

DATE: 20080714   TIME: 002546 – 010011 UT   Case A   Day Of CALIPSO Cycle: 9
STATION: Minsk, Belarus
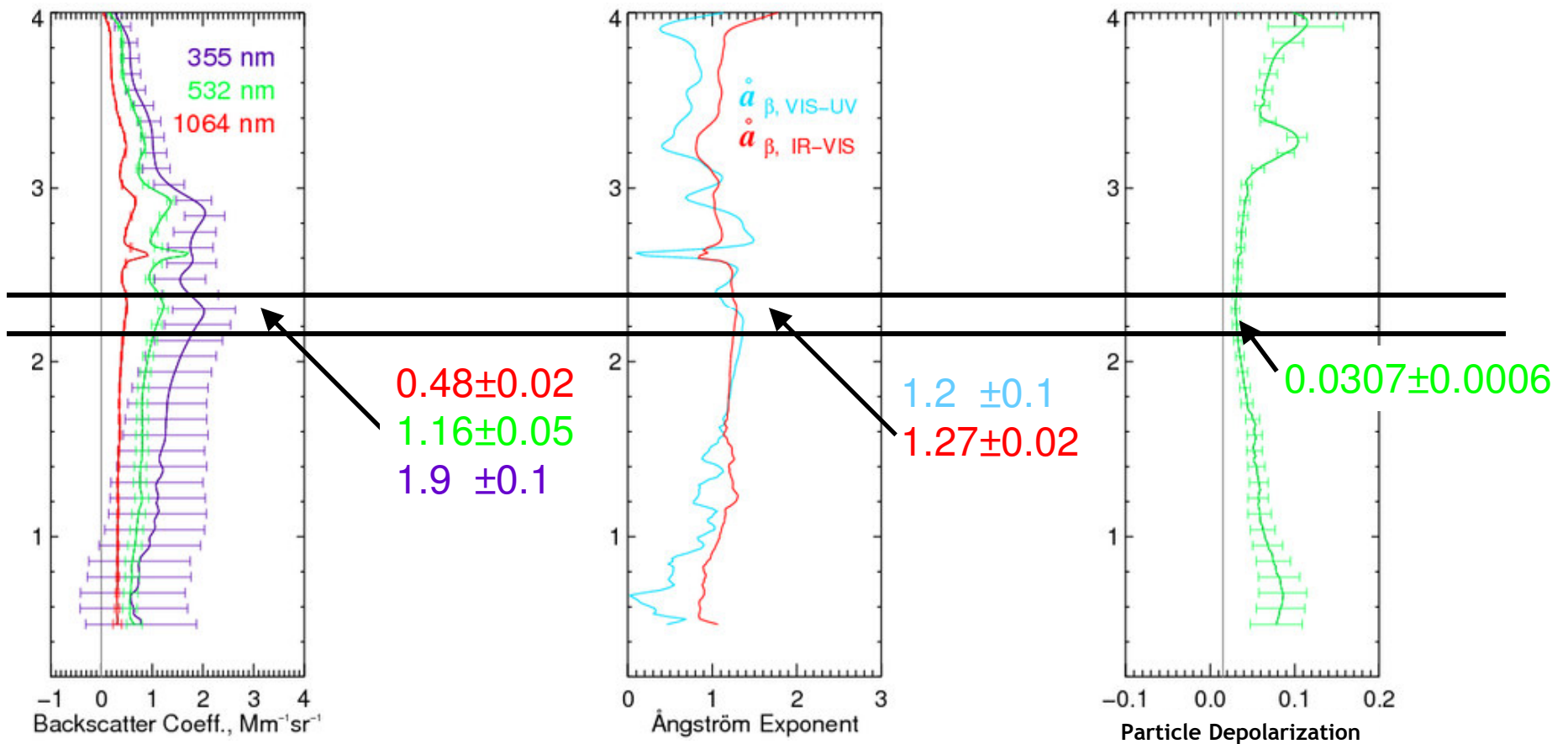
355 nm
532 nm
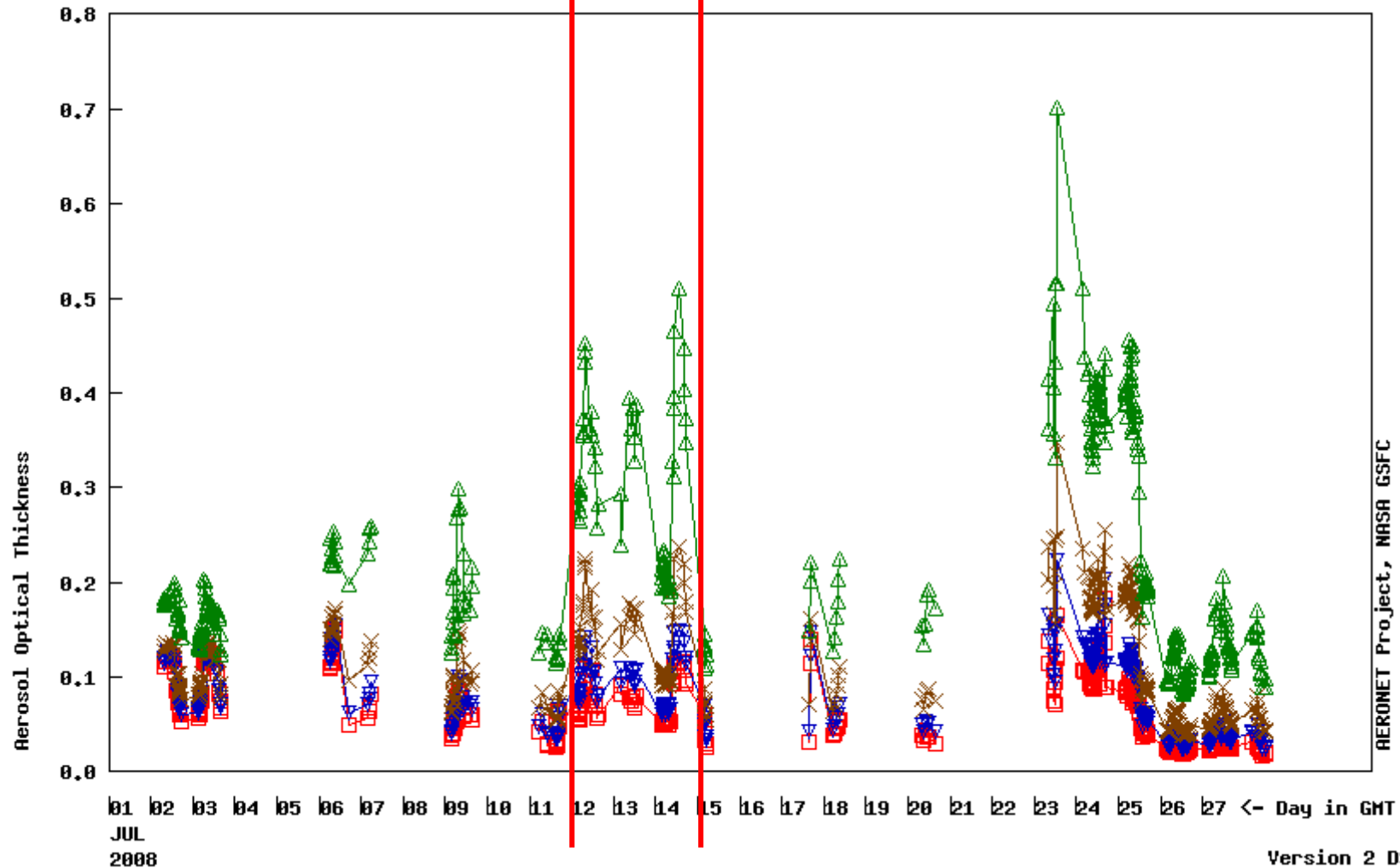1064 nm

0.48±0.02
1.16±0.05
1.9 ±0.1

$\overset{\circ}{a}$ β, VIS-UV
$\overset{\circ}{a}$ β, IR-VIS

1.2 ±0.1
1.27±0.02

0.0307±0.0006

Backscatter Coeff., Mm⁻¹sr⁻¹

Ångström Exponent

Particle Depolarization

AERONET Aerosol Optical Depth, Minsk, July 2008

Minsk , N 53°55'12", E 27°36'03", Alt 200 m,
PI : Anatoli_Chaikovsky and Philippe_Goloub, chaikov@dragon.bas-net.by and philippe.goloub@univ-lille1.fr
Level 2.0 AOT; Data from JUL 2008

AOT_1020 : ⟨0.064⟩
AOT_870 : ⟨0.078⟩
AOT_675 : ⟨0.112⟩
AOT_440 : ⟨0.220⟩

AERONET Project, NASA GSFC

Version 2 DS
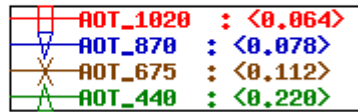
Clean continental aerosol

1) Case study: Minsk, 20 July 2008

AERONET Aerosol Optical Depth, Minsk, July 2008

Minsk , N 53°55'12", E 27°36'03", Alt 200 m,
PI : Anatoli_Chaikovsky and Philippe_Goloub, chaikov@dragon.bas-net.by and philippe.goloub@univ-lille1.fr
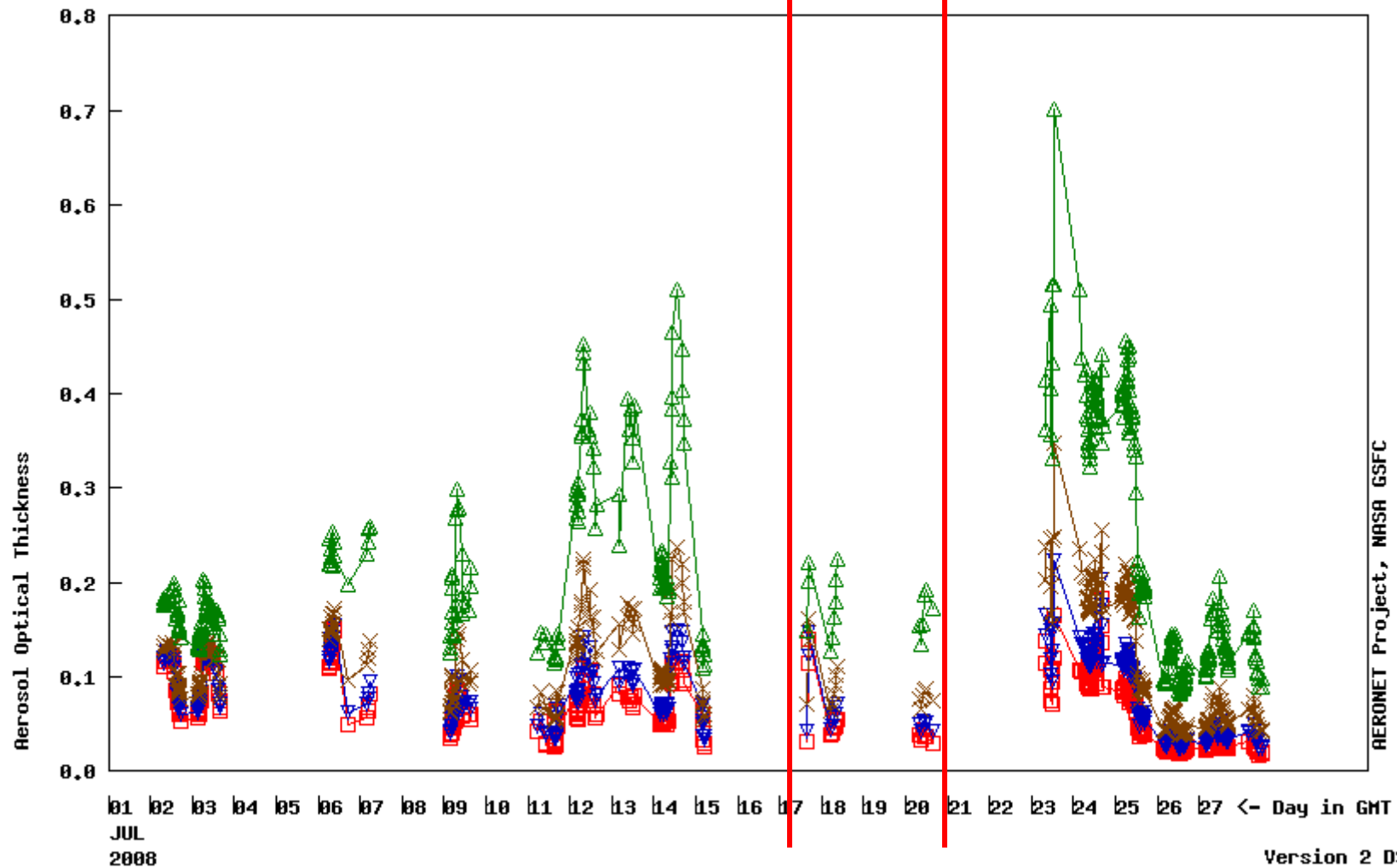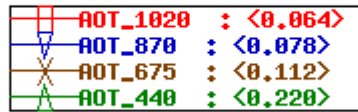Level 2.0 AOT; Data from JUL 2008

AOT_1020 : ⟨0.064⟩
AOT_870 : ⟨0.078⟩
AOT_675 : ⟨0.112⟩
AOT_440 : ⟨0.220⟩

AERONET Project, NASA GSFC

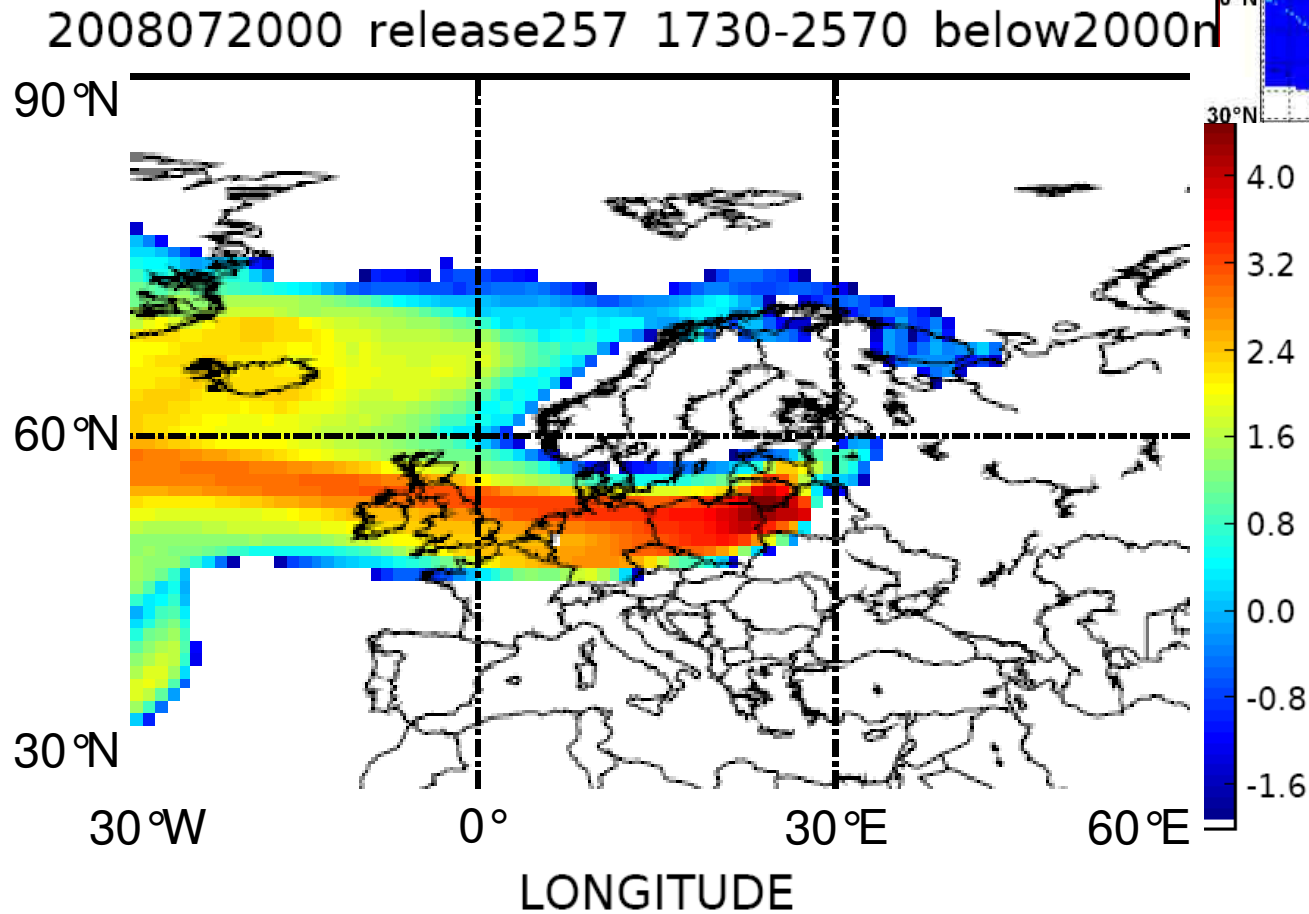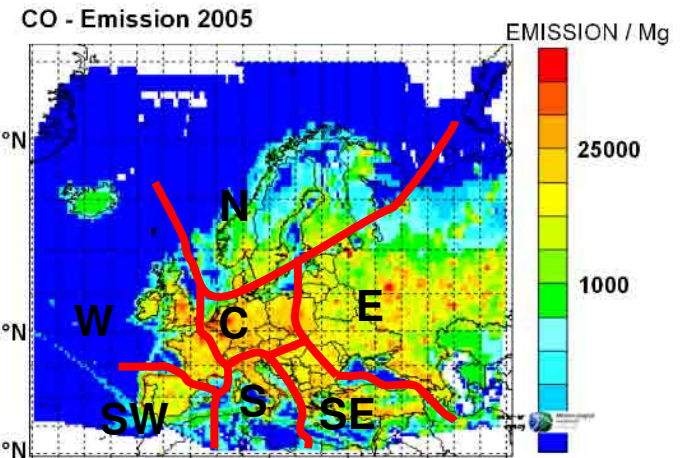Version 2 DS

Optical properties, Minsk, 20 July 2008, 11:57 – 11:26 UT

DATE: 20080720   TIME: 105701 – 112626 UT   Case A   Day Of CALIPSO Cycle: 15
STATION: Minsk, Belarus

Clean continental aerosol from Eastern Europe

CO - Emission 2005

EMISSION / Mg

70°N

N

0°N

W   C   E

30°N

SW   S   SE

25000

1000

2008072000 release257 1730-2570 below2000m

90°N

60°N

30°N

30°W   0°   30°E   60°E

LONGITUDE

4.0

3.2

2.4

1.6

0.8

0.0

-0.8

-1.6
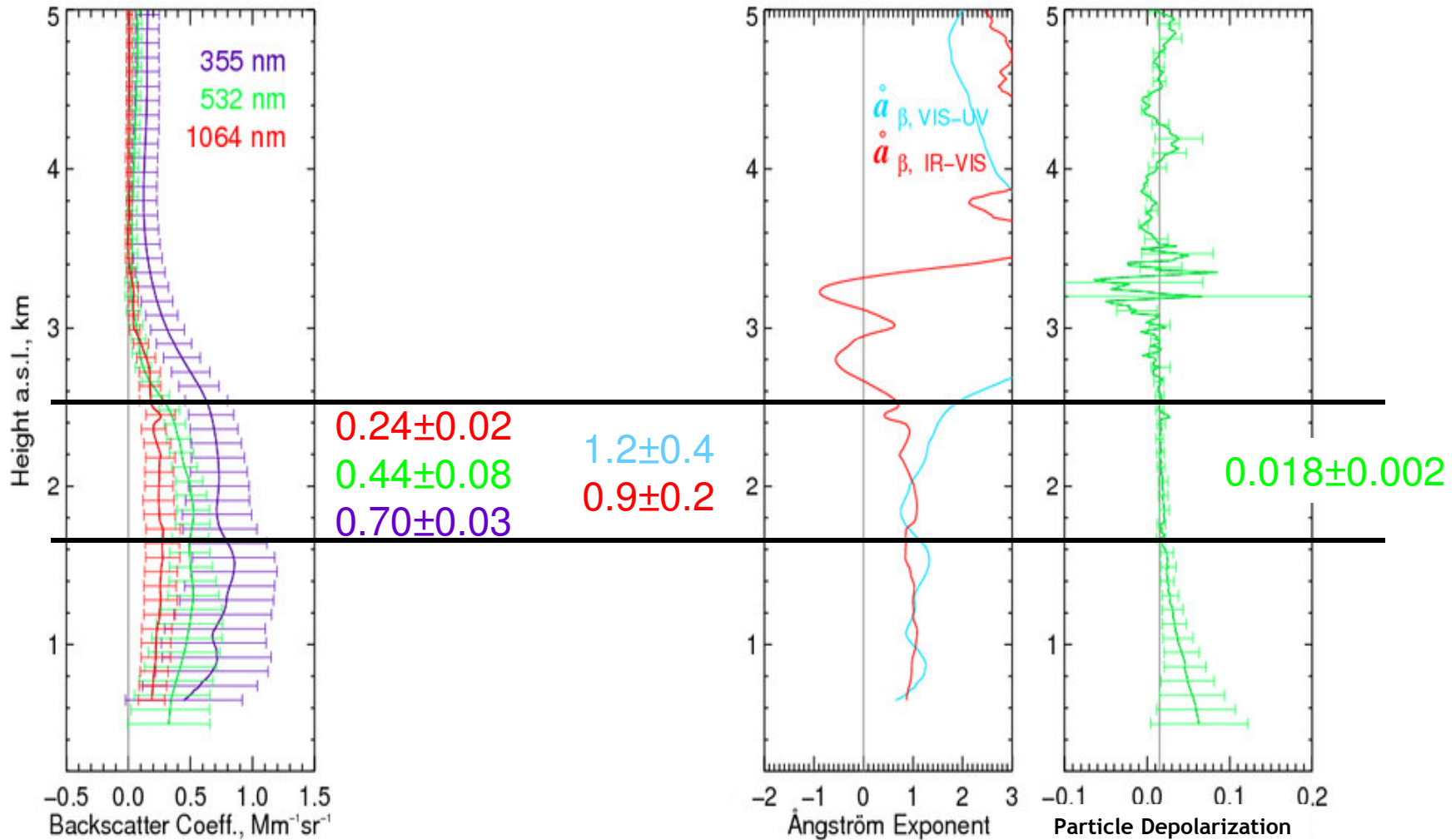
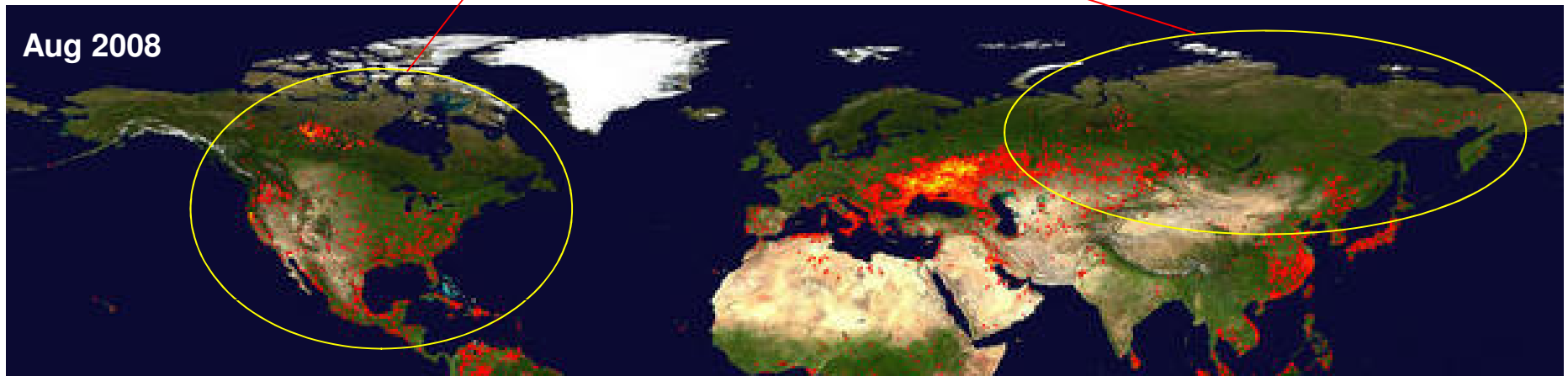**FLEXPART footprint (2000 m)** Minsk, 20 July 2008

eesa

Biomass-burning aerosol (smoke)

1) Fire source regions
2) Case study: Athens, 7-9 August 2008

Definition of fire source regions

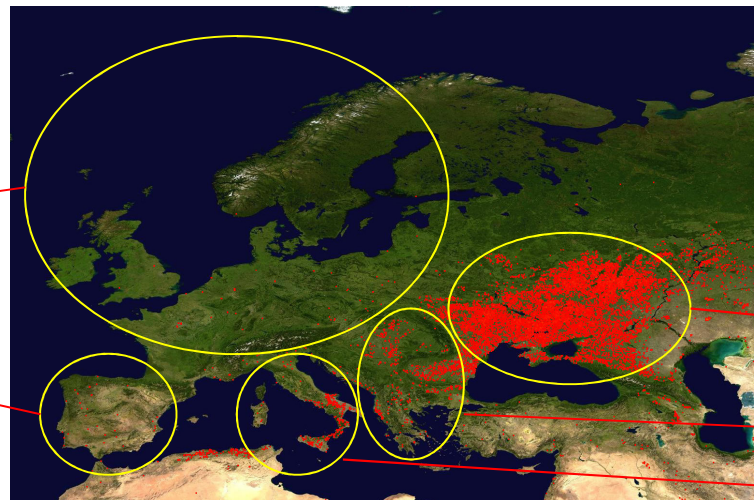**Extra-European:**   • Siberia
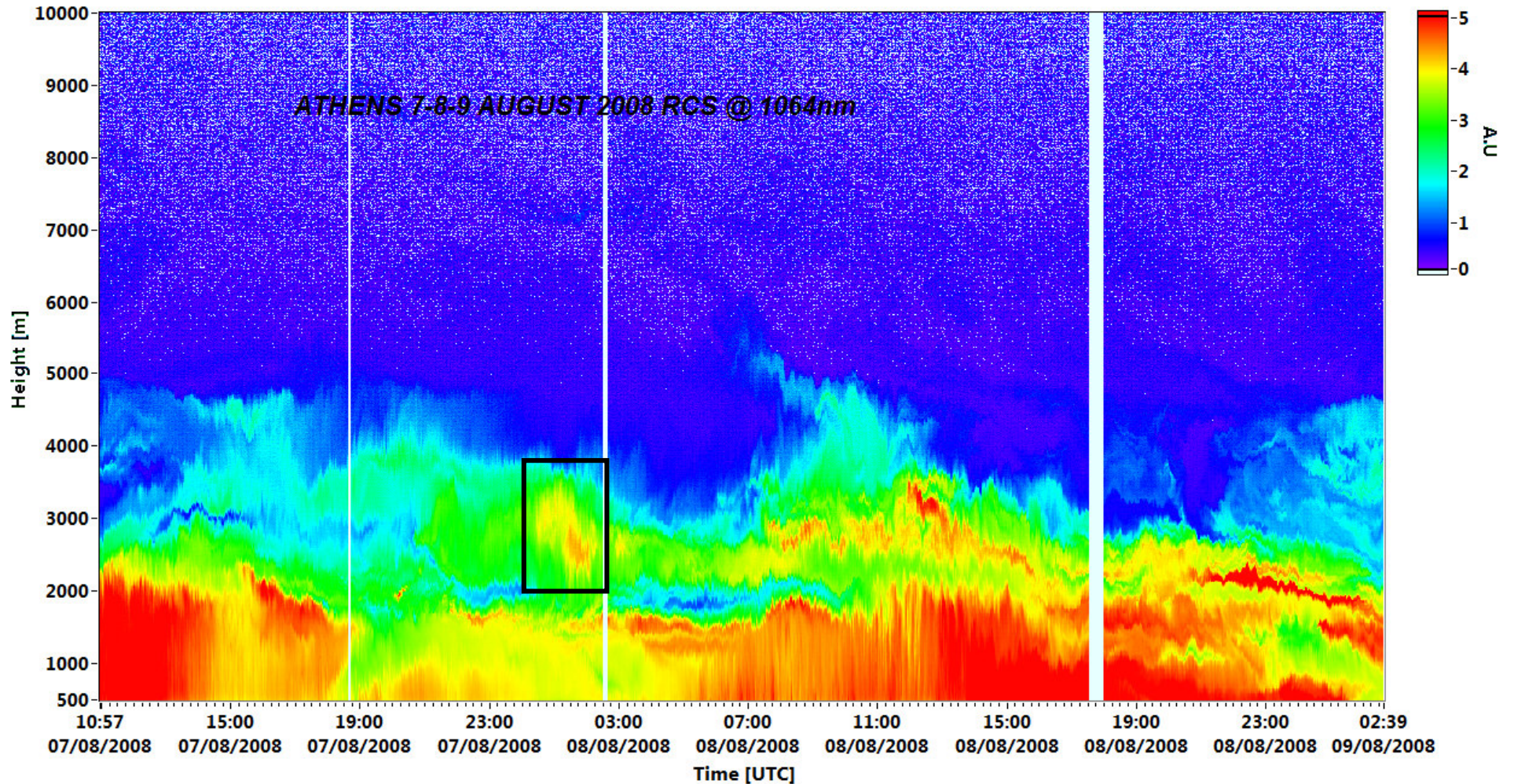   • North America

Aug 2008

European:

- central and northern Europe
- southwestern Europe
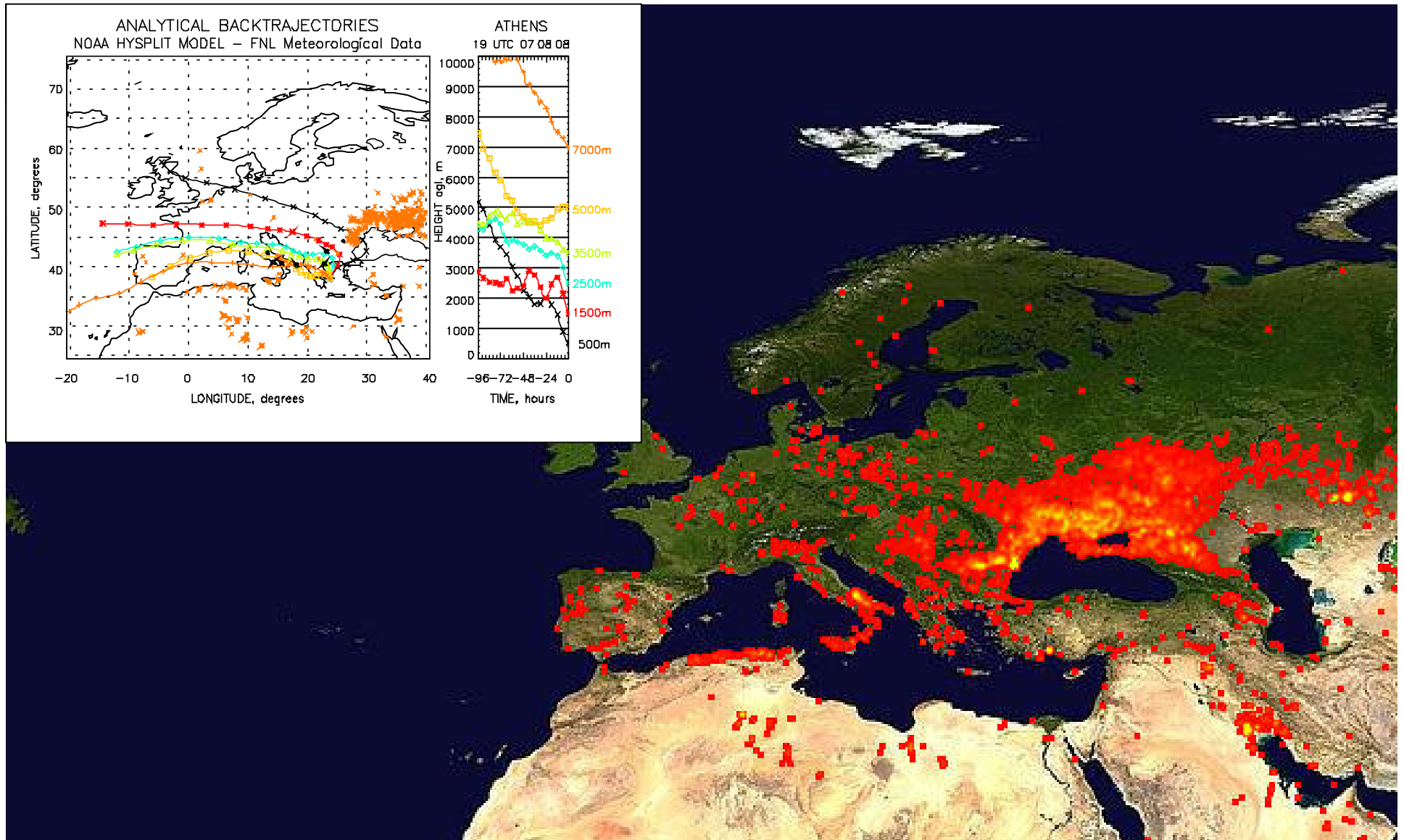
• Ukraine and surrounding areas
• southeastern Europe
• southern Europe

Athens, 7-9 August 2008, 1064-nm range-corrected signal
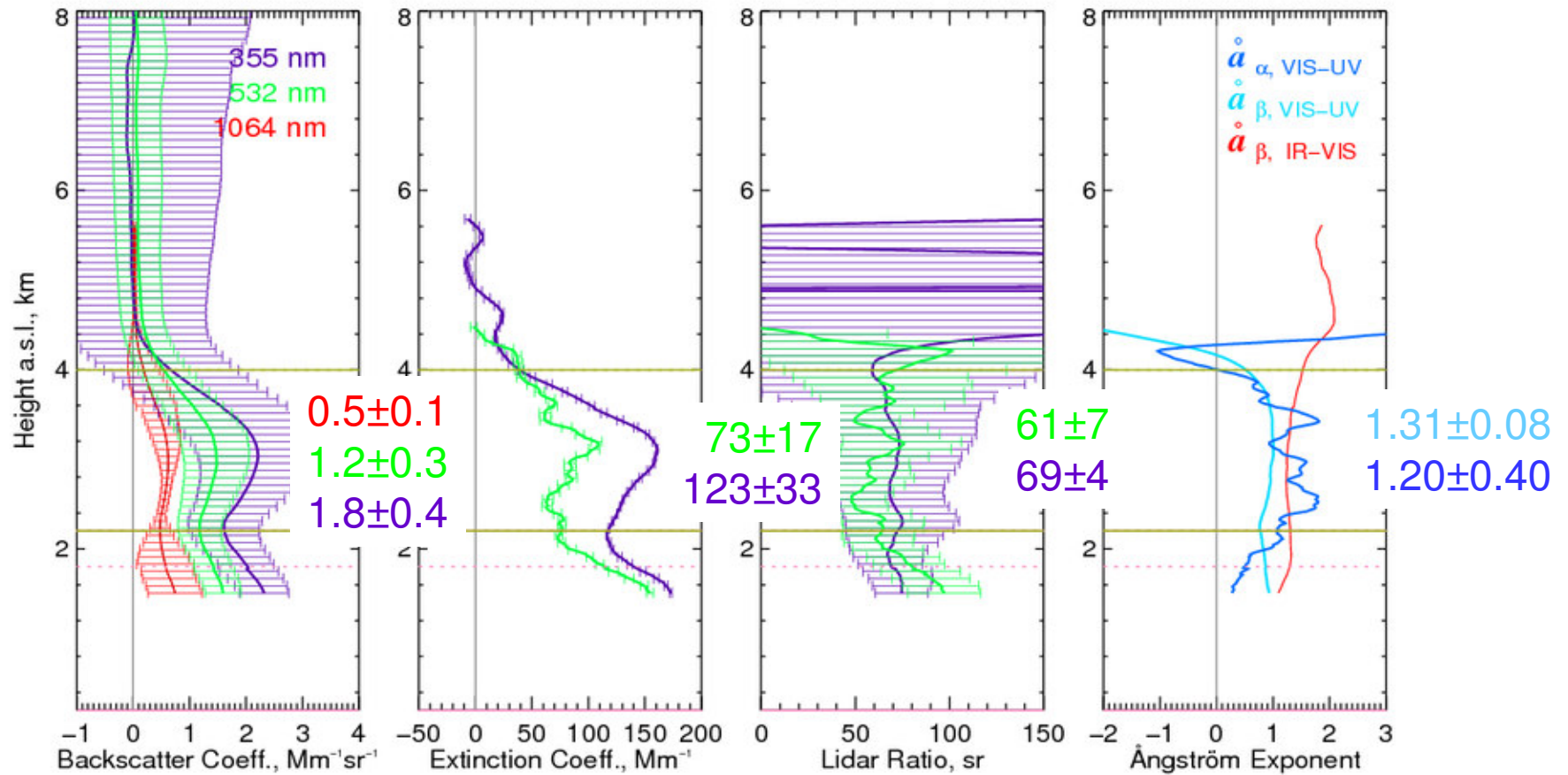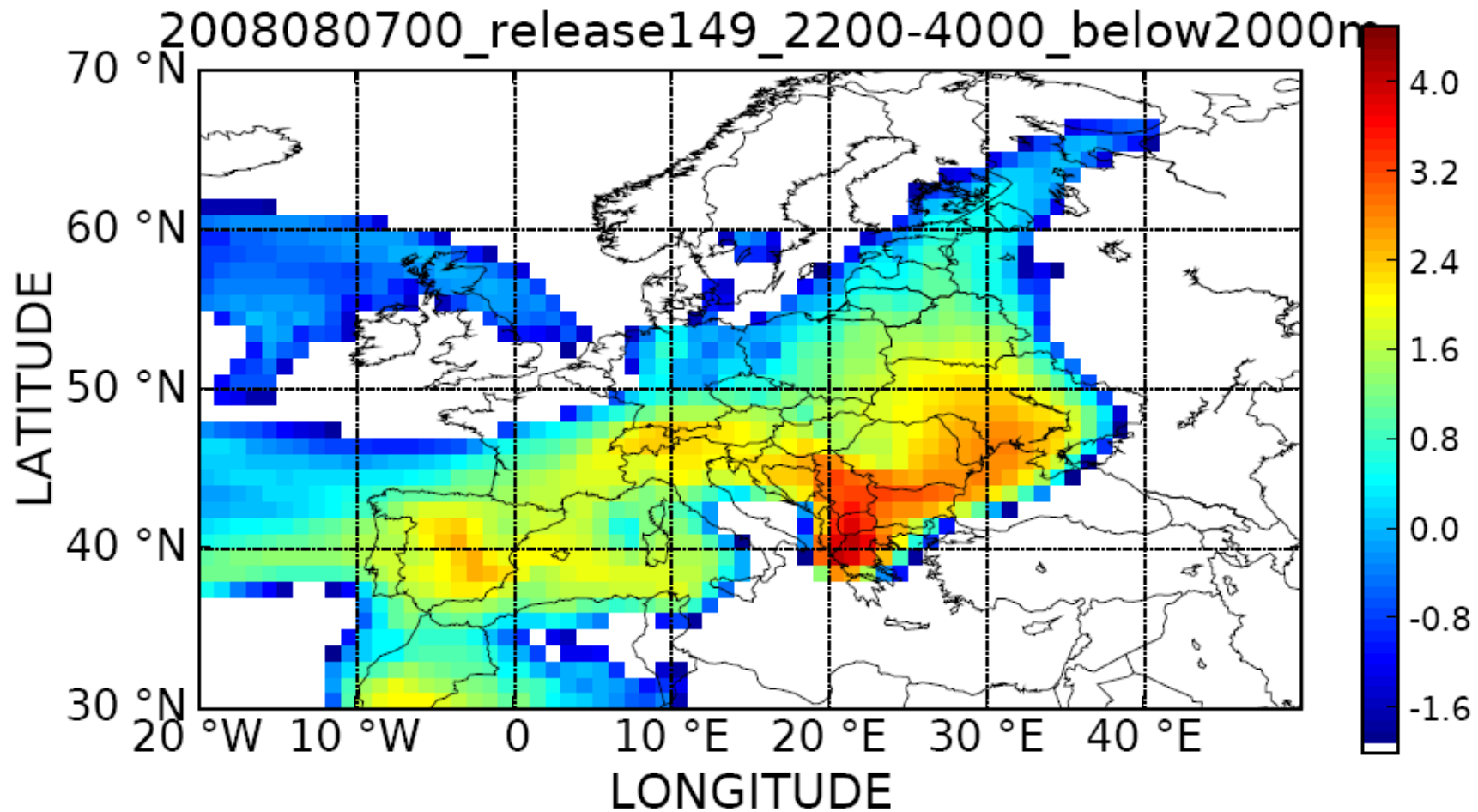

ATHENS 7-8-9 AUGUST 2008 RCS @ 1064nm

MODIS Fire Map 29 July- 7 August 2008 and

HYSPLIT backward trajectories

Optical properties, Athens, 8 August 2008, 00:21 – 00:50 UT

FLEXPART footprint below 2 km, Athens, 8 August 2008

2008080700_release149_2200-4000_below2000m
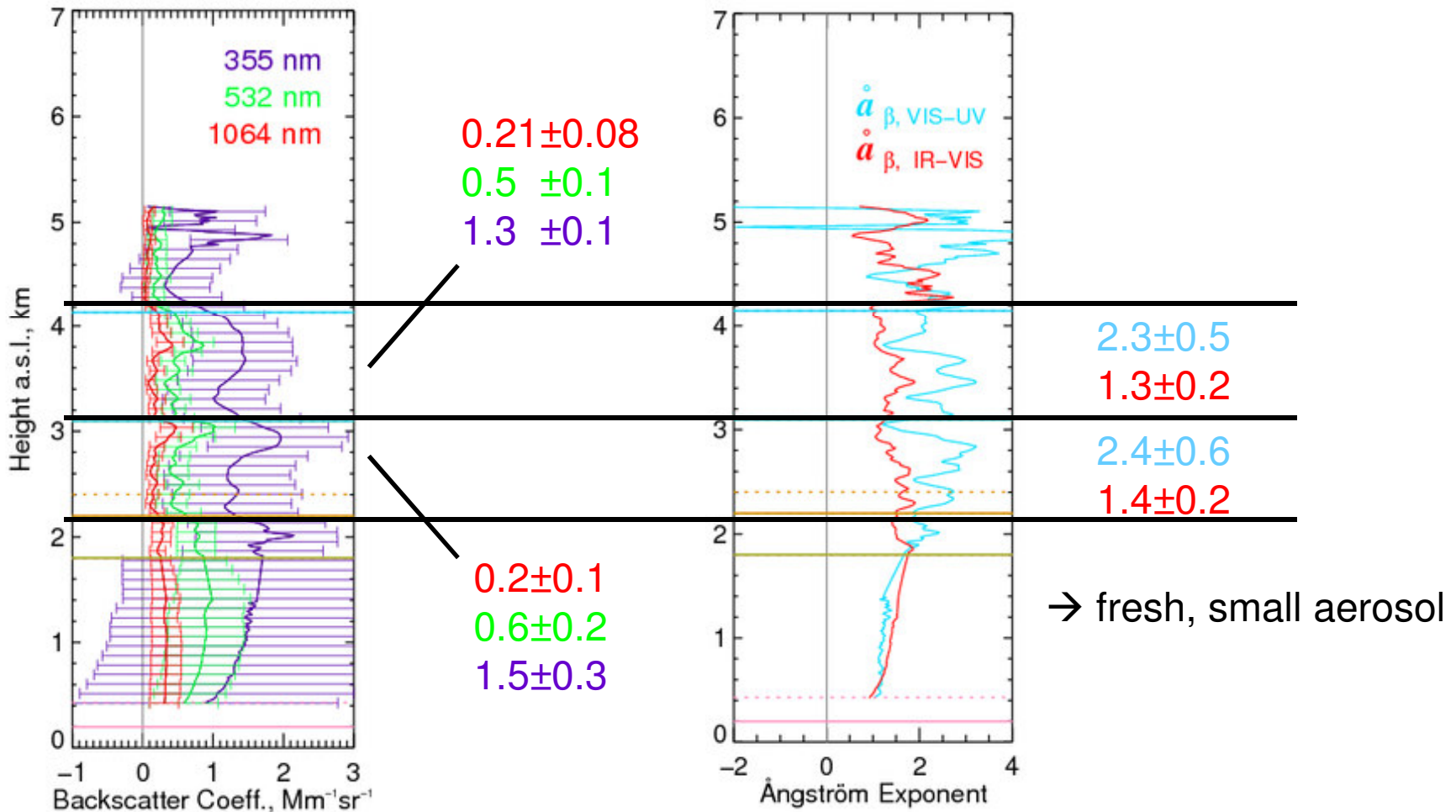
Long-range transport

Case study: Minsk, 13 May 2008
Lecce,   1 July 2008

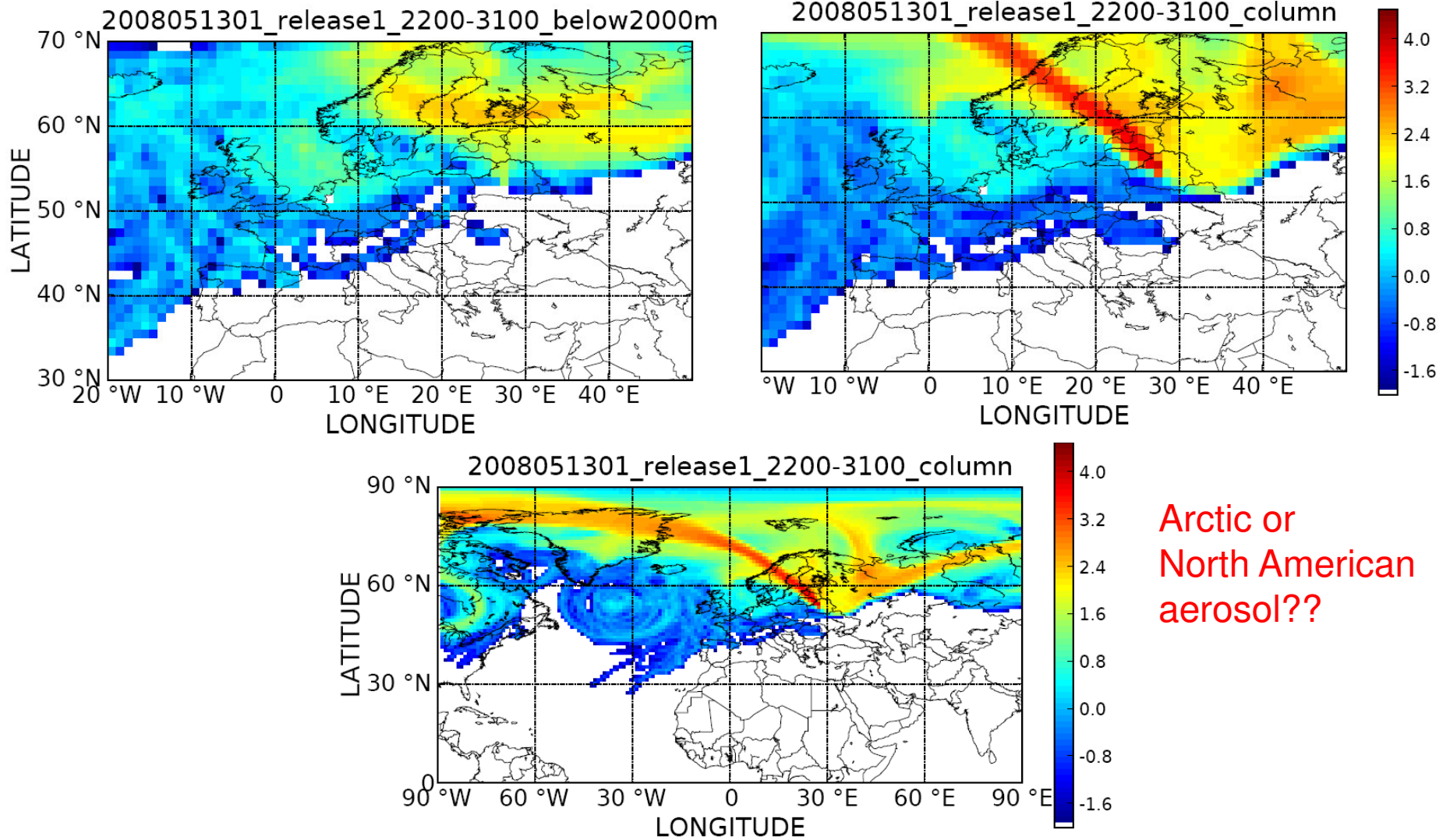# Optical properties, Minsk, 13 May 2008, 11:24 – 14:27 UT

DATE: 20080513   TIME: 112430 – 142752 UT   Case B   Day Of CALIPSO Cycle: 11
STATION: Minsk, Belarus

→ fresh, small aerosol

FLEXPART footprints, Minsk, 13 May 2008, 11:24 – 14:27 UT

2008051301_release1_2200-3100_below2000m

2008051301_release1_2200-3100_column

2008051301_release1_2200-3100_column

Arctic or
North American
aerosol??

Optical properties and FLEXPART footprints below 2 km, Lecce, 1 July 2008, 11:32 – 12:00 UT

DATE: 20080701   TIME: 113200 – 120000 UT
Day Of CALIPSO Cycle: 12   Case B
STATION: Lecce,Italy

355 nm

2008070104_release89_3300-4150_below2000m

2008070103_release88_2700-2900_below2000m
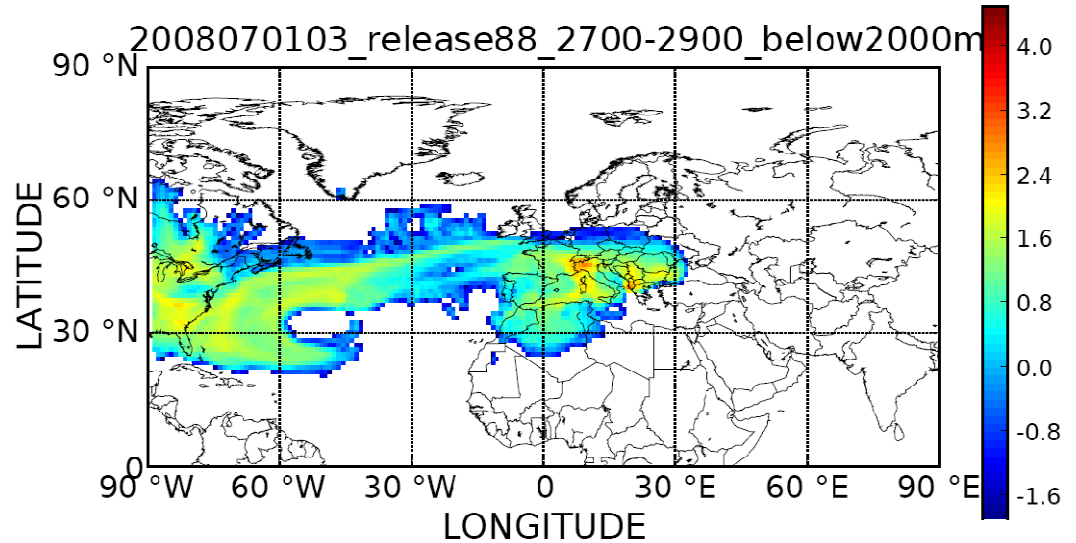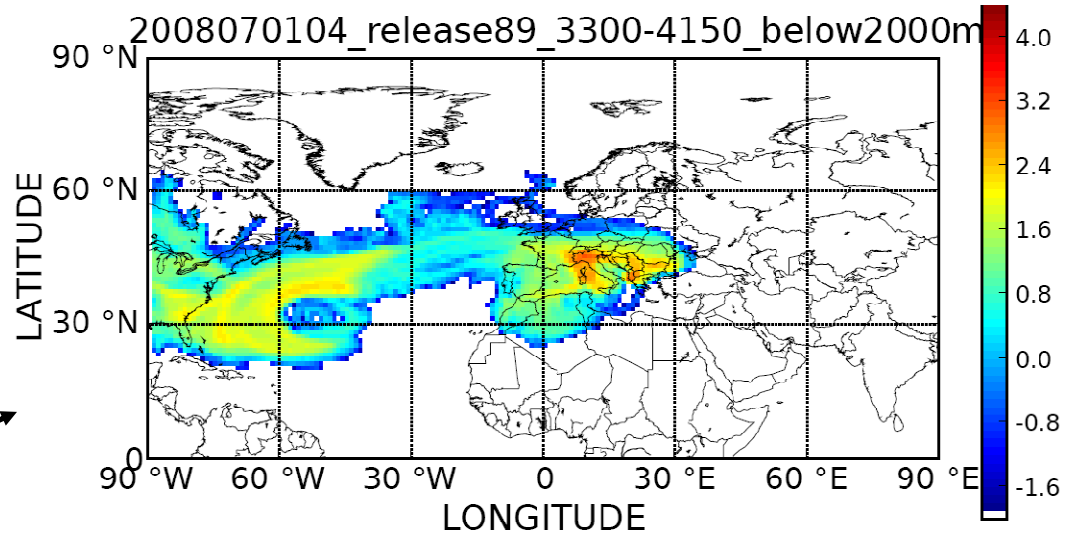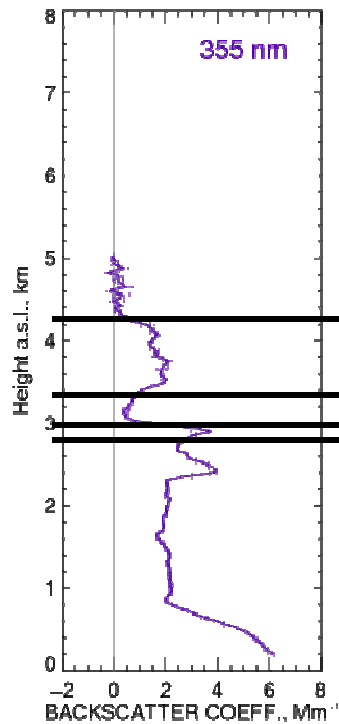
FLEXPART footprints column,
Lecce, 1 July 2008, 11:32 – 12:00 UT

2008070104_release89_3300-4150_column

2008070103_release88_2700-2900_column
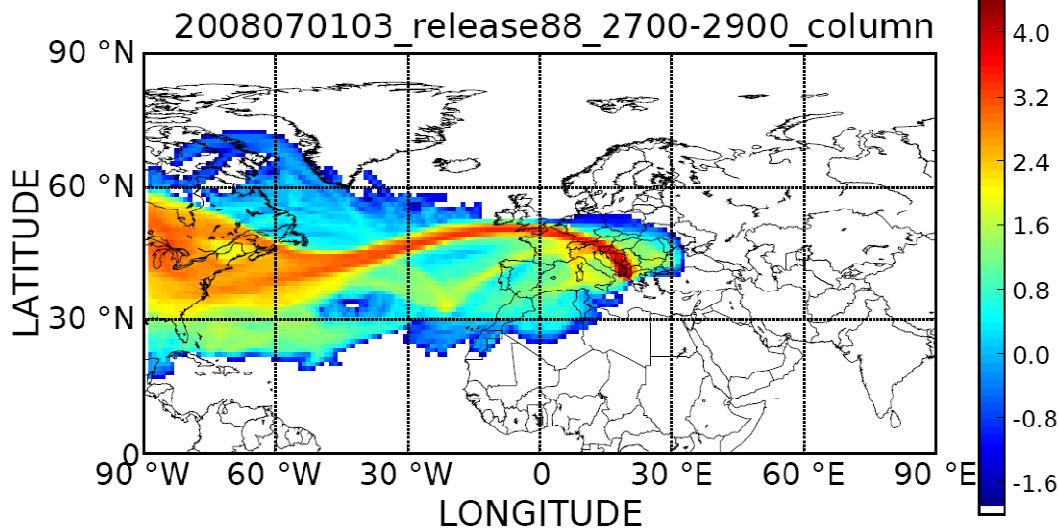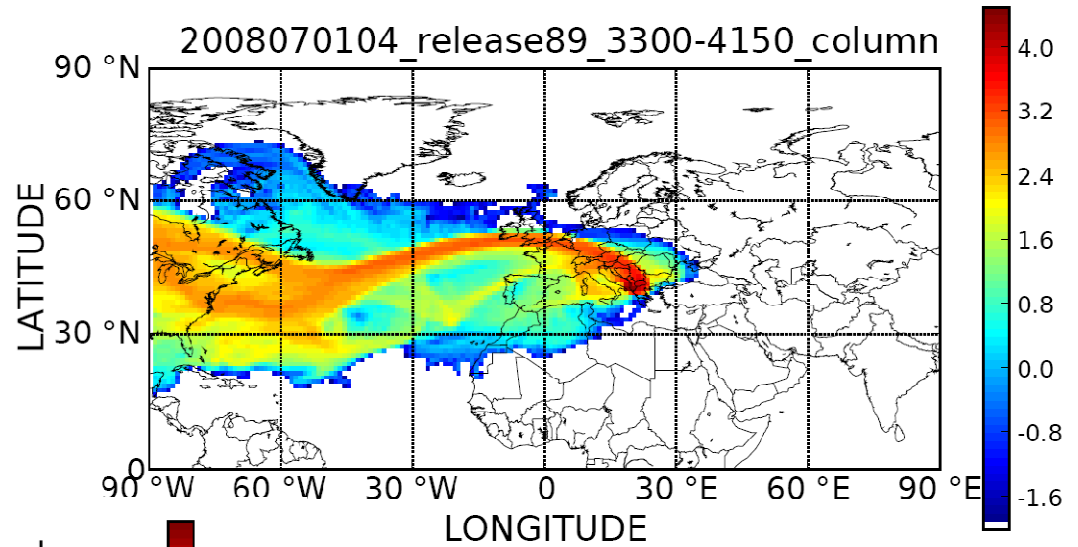
Maybe intercontinental transport?

Mixtures of different types

Case studies: Maisach, 30 May 2008
Hamburg, 31 May 2008

Optical properties, Maisach, 30 May 2008, 12:04 – 12:34 UT

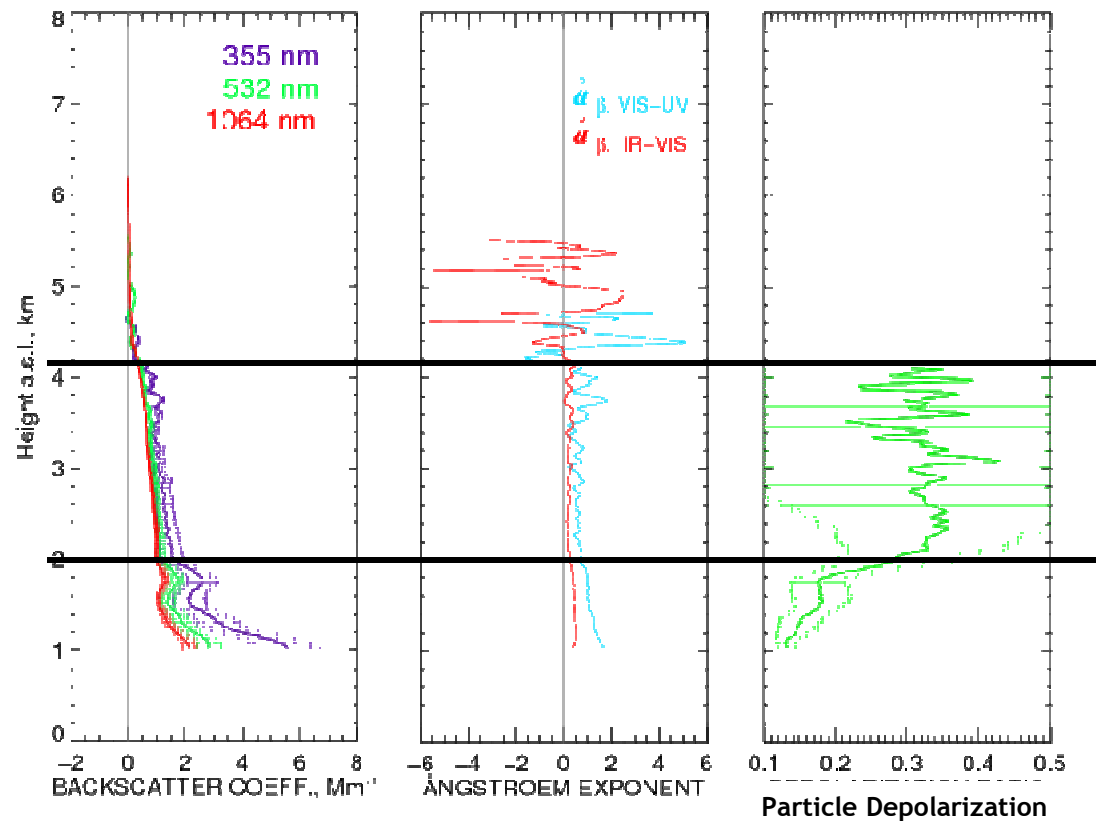DATE: 20080530   TIME: 120406 – 123400 UT
Day Of CALIPSO Cycle: 12   Case A
STATION: Maisach near Munich, Germany

FLEXPART footprint below 2 km, Maisach, 30 May 2008, 11:32 – 12:00 UT

2008053006_release46_2060-4080_below2000m
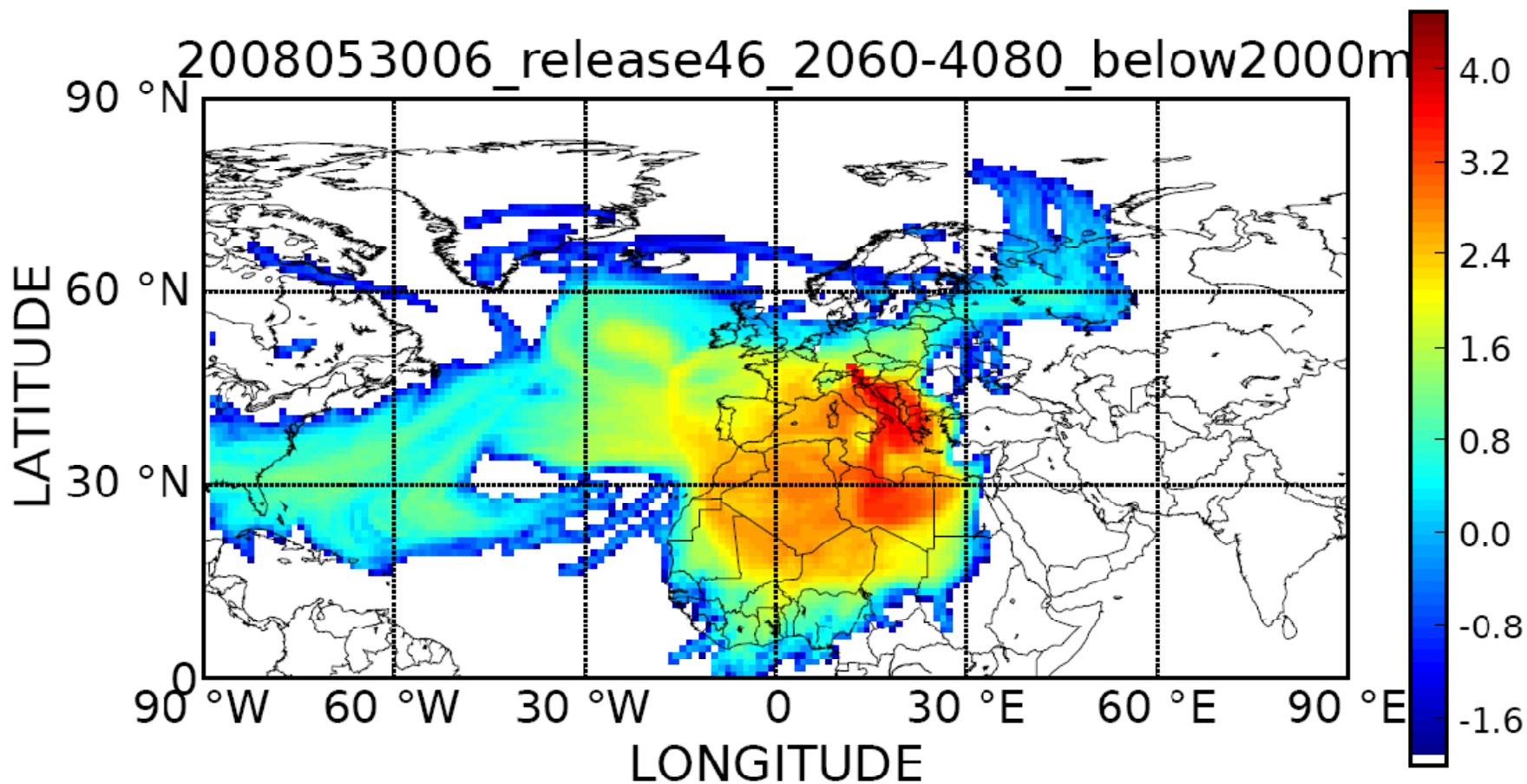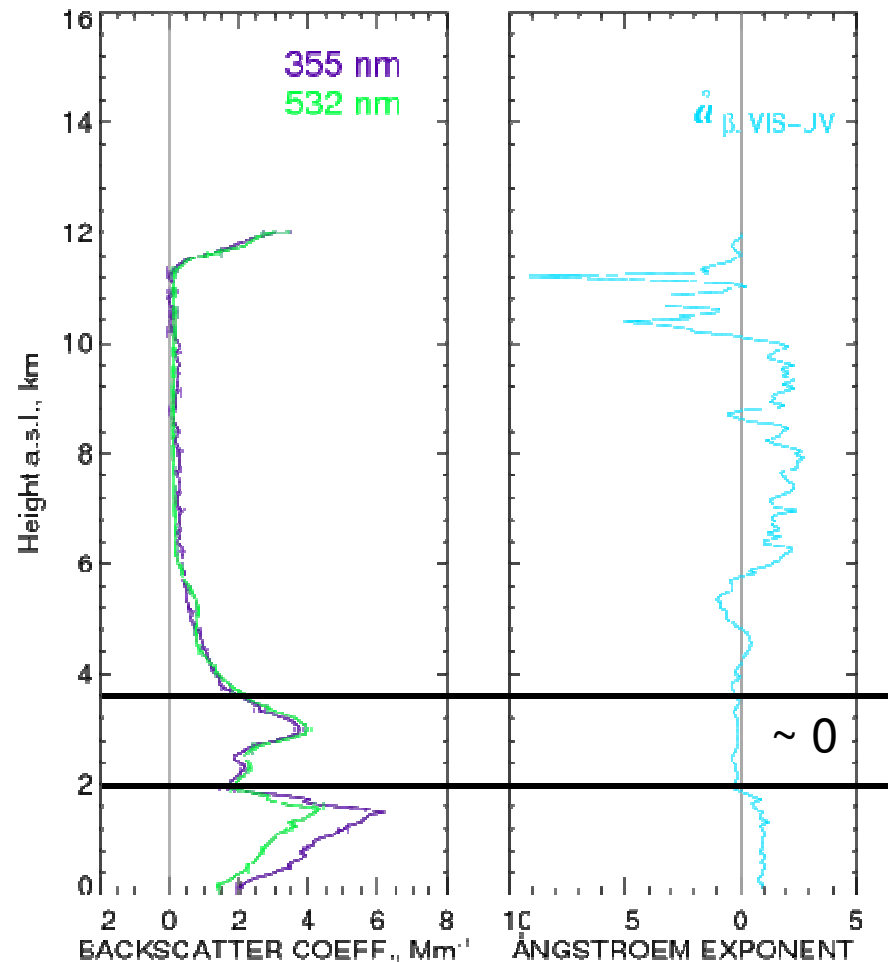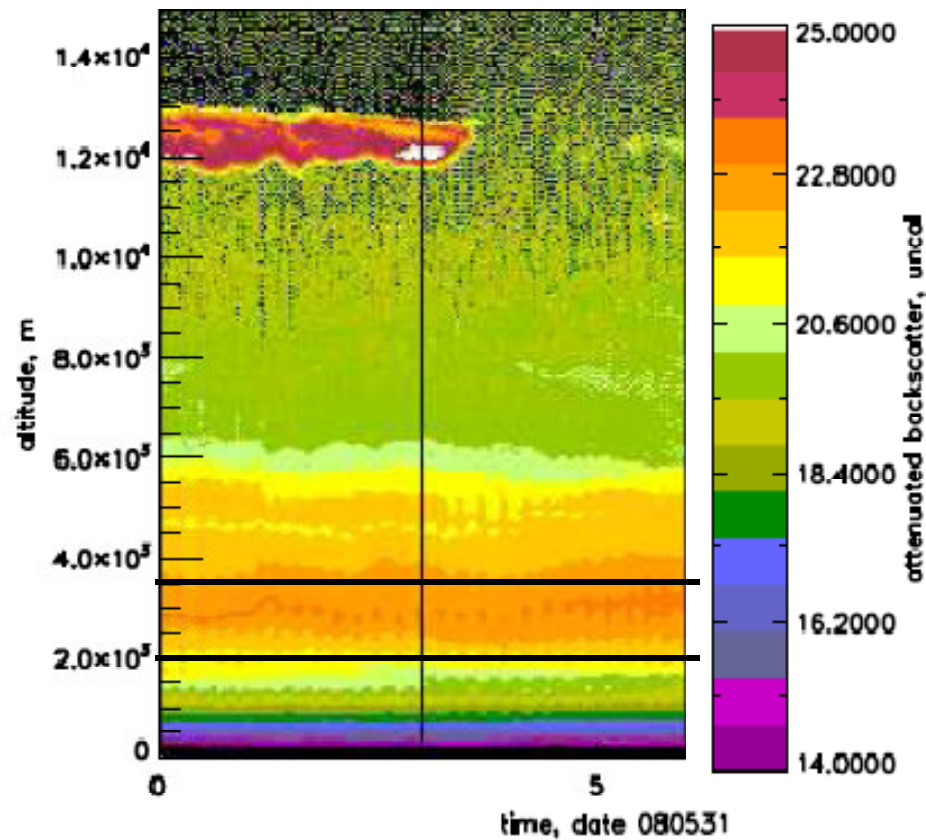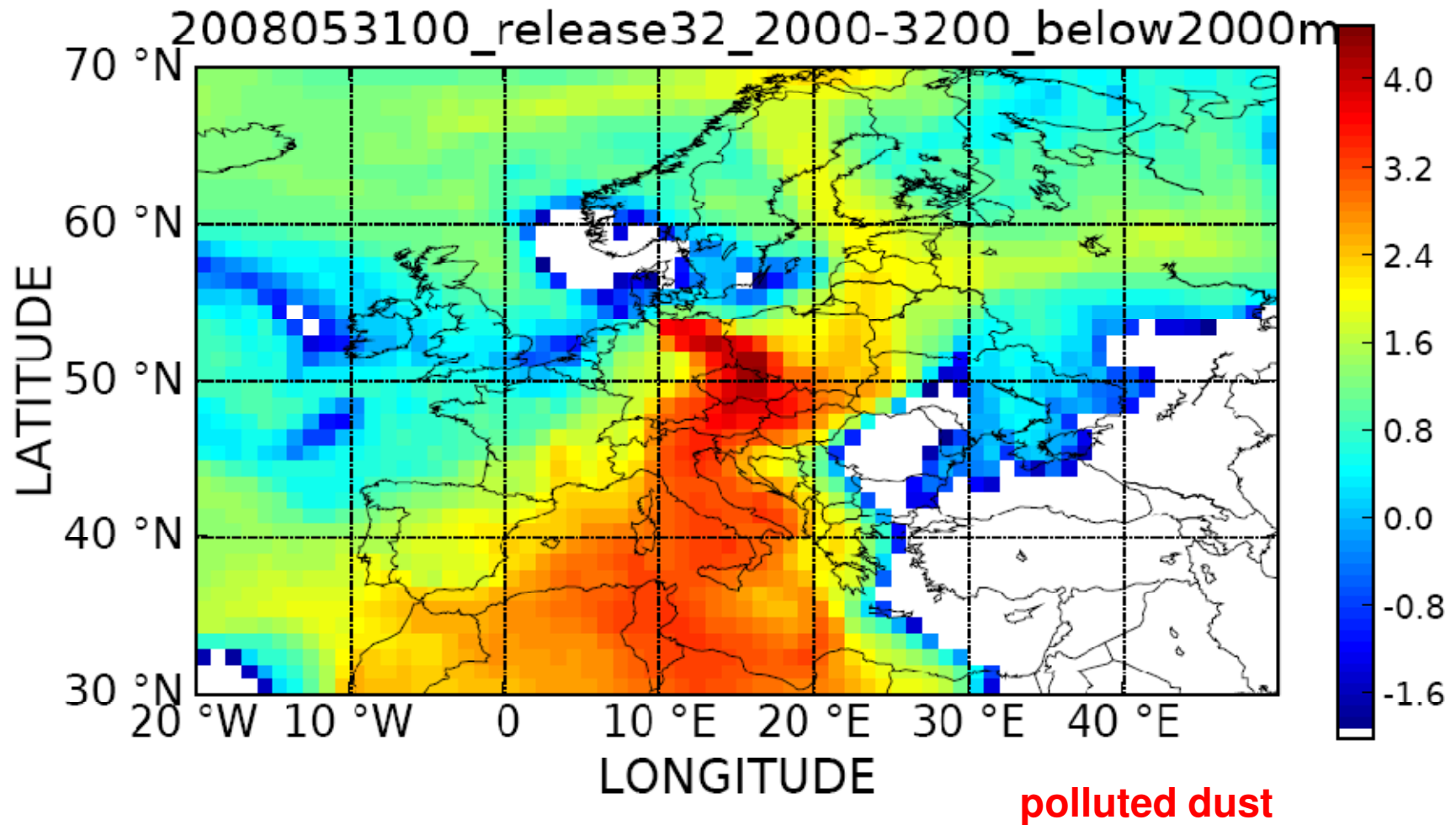
No pure Saharan dust!

Hamburg, 31 May 2008, 01:05 – 01:35 UT

1064-nm attenuated backscatter

DATE: 20080531   TIME: 010500 – 013500 UT
Day Of CALIPSO Cycle: 13   Case A
STATION: Hamburg, Germany

FLEXPART footprint, Hamburg, 31 May 2008, 01:05 – 01:35 UT

2008053100_release32_2000-3200_below2000m

polluted dust

Thanks for your attention!!

Questions?

Change of definition of CALIPSO aerosol type polluted dust

Polluted Dust

This aerosol model is designed to account for episodes of dust mixed with biomass burning smoke which are frequent in regions close to strong sources of both, for example in West Africa (cf. MODIS images) and Asia (cf. ACE-Asia, INDOEX). It also accounts for instances of dust mixed with urban pollution as is frequently encountered in parts of Asia and Europe. The CALIPSO polluted dust model is a mixture of the AERONET desert dust (coarse mode) and biomass burning (fine mode) clusters. This model yields an S_a value of 65 sr at 532 nm which is comparable to similar measurements of polluted dust (Liu et al., 2002: Voss et al., 2001). At 1064 nm, the S_a value for the CALIPSO polluted dust model is 30 sr.

Ali H. Omar, David M. Winker, Chieko Kittaka, Mark A. Vaughan, Zhaoyan Liu, Yongxiang Hu, Charles R. Trepte, Raymond R. Rogers, Richard A. Ferrare, Kam-Pui Lee, Ralph E. Kuehn, Chris A. Hostetler, The CALIPSO Automated Aerosol Classification and Lidar Ratio Selection Algorithm. *Journal of Atmospheric and Oceanic Technology*, early online release.

Optical properties, Minsk, July 2008

measurement station	Minsk	Minsk
Date	14 July 2008	20 July 2008
time/UT	00:25 – 01:00	11:57 - 11:26
bottom height	2200	1730
top height	2420	2570
bsc_ir	0.48±0.02	0.24±0.02
bsc_vis	1.16±0.05	0.44±0.08
bsc_uv	1.9±0.1	0.70±0.03
vis-to-uv-bsc-angstr	1.2±0.1	1.2±0.4
ir-to-vis-bsc-angstr	1.27±0.02	0.9±0.2
depol_vis (Particle)	0.0307±0.0006	0.018±0.002

polluted continental aerosol

clean continental aerosol